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Public works department maintenance management information system

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PUBLIC WORKS DEPARTMENT MAINTENANCE MANAGEMENT INFORMATION SYSTEM

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NAVAL POSTGRADUATE SCHOOL
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THESIS

PUBLIC WORKS DEPARTMENT MAINTENANCE
MANAGEMENT INFORMATION SYSTEM

by

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and
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June 1976

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Public Works Department Maintenance Management Information System

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ABSTRACT

This thesis reviews the facilities maintenance management program as applied to naval shore activities, to assess and determine what maintenance management information is needed and provided at the Public Works Officer's level of management. The organizational hierarchy of the U.S. Navy, which serves as the budget path for the Operation and Maintenance, Navy (O&MN) appropriation, is related to the hierarchies of management responsibilities and information systems. The authors conclude that the Public Works Officer is primarily an operational manager, that he needs to be able to evaluate and analyze achievements in relation to stated objectives, and that the existing annual maintenance plan is deficient. The concept of the Budgeted Maintenance Plan (BUMP) is recommended to provide the means for evaluation on an annual basis and to provide a microeconomic tool to transform objectives into an efficient operating plan and budget.

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I. INTRODUCTION

A. SCOPE

The inflationary spiral associated with the price of labor and materials combined with the unwritten procedure for near level to incremental budgeting has seriously impacted on the Navy's facilities maintenance program. This situation has resulted in constraints which have left the Public Works Officer with an ever-expanding list of maintenance deficiencies. The inflationary spiral has affected not only the Navy's facilities maintenance but the Navy's operations in general and possibly its status as a defense arm of the national defense team. The funds simply do not provide the same coverage as in previous years and management must find more effective means to accomplish the task of dollar stretching. Mechanization has its application in production operations because of the repetitive nature of many identical items, but the uncommon features associated with maintenance make it heavily dependent for its accomplishment in the manual mode.

The manager needs to ask questions and make decisions concerning the utilization of the maintenance resources. He should be asking questions like: Where are the maintenance monies being spent? Can these expenditures be reduced? Are the expenditures justified in meeting the corporate objectives? Can management be improved? To approach rational decisions on these issues, the manager must receive accurate and relevant information on which to base his analysis.

The accounting system within the defense establishment and the Navy is oriented toward financial accounting and the official record. Under this accounting system, without special attention, the maintenance manager may know how much is spent in general, but not know specifically where and how the maintenance funds are being spent. A form of managerial accounting is justified for establishing functional controls within the maintenance program. Managerial accounting procedures would be valuable in providing data and information to serve as the basis for arriving at decisions for the type of questions stated above.

The complexity and magnitude of the maintenance management program was sufficient to warrant singular attention as a management system. The authors purposefully have restricted this thesis to the study of the maintenance management program. It was recognized that other Public Works programs like Housing, Utilities, and Transportation exist and have certain similar and unique features as compared with the studied program. Each of these programs justify individual attention; however, time did not permit a detailed study of each program within the jurisdiction of Public Works management.

This thesis focuses on the utility of the information received by the Public Works Officer at a Naval Shore Activity. It reviews the input streams of budget resources and work requirements and comments on the informational system currently in use. The Public Works Department Management System (PWDMS), both partially published and in draft form, is reviewed and

analyzed for application at the study site. The Public Works Officer is classified mainly as an operational manager rather than a strategic manager. The foremost finding is the lack of a means to evaluate or gauge the yearly performance of the maintenance effort. A means to close the planned versus actual gap between budgeting and maintenance performance is recommended.

While this study focused on the Public Works Department at the Naval Postgraduate School in Monterey, California, it has general application at all Public Works Departments within the Naval Shore Establishment and particularly those of similar size. The primary factors which have application are: (1) The annual maintenance plan, (2) Managerial accounting at the maintenance level, and (3) The budgeting and maintenance interface. These factors serve to enhance the planning and control functions and provide the means to more effectively budget for specific maintenance deficiencies. The above factors vary only by the means of implementation at a given Public Works Department. That is to say, that the need, size and availability of resources would affect the type of implementation regardless if it be automated, manual or a combination of manual and automated. The question to automate or not must be answered on an individual basis.

B. PROBLEM STATEMENT

The Naval Facilities Engineering Command, through its facilities arms, has presented the Public Works Officer with policies, objectives, and procedures by which the maintenance

function is to be performed. This guidance serves as the foundation on which the local maintenance program is constructed.

Information performs a vital role in the maintenance manager's environment. The maintenance management information system must provide the means to effectively manage the maintenance function of the operating activity. The failure of management to create, control, and communicate information is costly and results in fewer services from the maintenance unit [Ref. 25, p. 1]. This failure by management is most likely manifested within the Public Works Officer when he begins to feel that he is operating in a vacuum. This is the old feeling of being unable to get the proper information in a routine manner, having to specifically search out the needed information, and being uninformed in general.

This thesis is specifically concerned with the informational needs of the Public Works Officer. The authors feel that, typically, the Public Works Officer does not have the time to objectively define his informational needs and, as such, fails to recognize the need for a good, useable, annual maintenance plan. Furthermore, if an annual maintenance plan exists, it is not used as a basis to evaluate the performance of a Public Works Department as it could be.

C. OBJECTIVES

The U.S. Navy through the Naval Facilities Engineering Command has provided management systems for the use of the Public Works Officer. These systems have generally been

developed at the headquarters level and represent their conceived needs of the Public Works Officer. It is understandable that management control policy must come from strategic management in clear, concise, and objective statements. Likewise, the management system must be designed to aid management at both the operational and headquarters level and, as such, requires management attention both up and down the management chain.

This thesis is concerned with the informational needs of the Public Works Officer. The thesis objectives, therefore, are: (1) To identify the maintenance management informational needs of the Public Works Officer, and (2) To recommend changes in the current maintenance management information system based on these needs.

D. METHODS OF STUDY

Personal interviews with knowledgeable managers in Public Works maintenance, maintenance control, accounting and comptrollership at the Naval Postgraduate School contributed background as perceived at the various levels of management and control. A directed study course provided a review of modern information systems with emphasis on why they fail and the problems involved in development and implementation. The course also included a review of steps involved in an Automated Data System Developments (OPNAVINST 5231.1), an overview of the Navy Facilities System (NAVFAC P-424), and a detailed review of the Public Works Department Management System (NAVFAC P-428). Current Department of Defense and Navy instructions

were reviewed to assess the existing reporting system. Reviews of automated and manually prepared reports provided background on how effectively the reports were serving management. Visits to the Authorized Accounting Activity and its data processing center revealed the fact that financial reports were the official accounting record and the Public Works management reports (TAB-A&B), as currently programmed, were basically useless. The TAB-B Report Program proved to be poorly maintained and failed to even provide the information as called for by its title. Finally, the personal experiences and observations of the authors have influenced their philosophy of practical results. This philosophy has been influenced by tours as Transportation Officer at a Naval Station, Shops Engineer at a Naval Air Station, Assistant Public Works Officer at a Naval Station, Public Works Officer at a Naval Hospital, and Projects Officer at a Naval Shipyard.

E. SUMMARY

This thesis reviews the facilities maintenance management program as applied to naval shore activities, to assess and determine what maintenance management information is needed and provided at the Public Works Officer's level of management. In addition to general discussion about maintenance and the maintenance management information problems, Chapter I has explicitly stated the basis on which the thesis is developed.

Chapter II reviews the organizational hierarchy of the U.S. Navy from the Chief of Naval Operations to the Public Works Department at a naval shore activity. This hierarchy

serves as the budget path for the Operation and Maintenance, Navy (O&MN) appropriation. This chapter discusses the standard Public Works Department organization and presents a brief responsibility statement for each of the seven divisions in a standard Public Works Department.

Chapter III relates financial management to the budget process and the organizational hierarchy of the Navy. This chapter makes the distinction between capital and operating budgets and explains the Planning, Programming and Budgeting System as used in the Department of Defense. The processes of budget formulation, budget execution and accounting at the activity level are presented.

Chapter IV reviews the maintenance phases of planning, execution and appraisal as provided by the Naval Facilities Engineering Command in the "Maintenance Management of Public Works and Public Utilities," MO-321, manual.

Chapter V highlights the current financial and managerial reports which are required by the Resources Management Systems, the Naval Facilities Engineering Command and the Public Works Officer. The chapter also relates the fact that the station comptroller is responsible for financial reporting and control.

Chapter VI presents the Naval Facilities Engineering Command as the proponent for the Naval Facilities System. It then provides a listing of the Automated Data Systems composing the Naval Facilities System and discusses the Public Works Department Management System (PWDMS).

Chapter VII provides a literature review on the subject of Management Information Systems (MIS). Several broad

definitions of MIS and its evolution as related to the continually improving hardware and software technology is presented. Management Information Systems are related to the hierarchies of information systems and management responsibilities.

Chapter VIII examines the Public Works Officer's information needs in the specific function of maintenance management. First, the Public Works Officer is classified by the type of management he exercises, the maintenance objective is identified and then the information needed to aid him meet the maintenance objective is identified and discussed. An idealistic, comprehensive information system is developed to provide the information needed in achieving the maintenance objective.

Chapter IX analyzes existing information systems to see how well the maintenance manager's information needs are being fulfilled. Concepts of the comprehensive MIS are reviewed to determine practical solutions to information problems.

Chapter X lists recommendations that were generated in the analysis to correct informational deficiencies in Public Works maintenance management. Recommendations made are both specific to the Public Works Department at the Naval Postgraduate School and general to Navy-wide application.

Chapter XI concludes that the Public Works Officer is primarily an operational manager, that he needs to be able to evaluate and analyze achievements in relation to stated objectives, and that the existing annual maintenance plan is deficient. The concept of the Budgeted Maintenance Plan (BUMP) is recommended to provide the means for evaluation on an annual

basis and to provide a microeconomic tool to transform objectives into efficient operating plans and budgets.

II. ORGANIZATIONAL HIERARCHY IN THE NAVY

This chapter reviews the operational and the logistical support structure of the United States Navy, illustrating the two paths by which facilities and facilities maintenance are funded. The Naval Facilities Engineering Command is the Systems Command under the Naval Material Command which is responsible for Public Works and facilities in general. The operational chain is from the Chief of Naval Operations (CNO) via the major claimants to the individual shore activity for the operation and maintenance appropriation.

A. THE UNITED STATES NAVY

The Department of Defense, as established by the National Security Act Amendments of 1949, exercises executive control over the Department of the Navy (along with the Departments of the Army and Air Force).

The objectives of the Department of the Navy are to perform military missions as directed by the President or the Secretary of the Defense. These objectives are [Ref. 51, p. 1]:

1. To organize, train, equip, prepare and maintain the readiness of Navy and Marine Corps forces and,

2. To support Navy and Marine Corps forces.

The United States Navy is structured into two broad organizational divisions, the operational and the logistic support forces, both of which are under the direct control of

the Chief of Naval Operations (CNO). The operational forces are commanded by headquarters components, which are major claimants, while the logistic forces are headed by the Chief of Naval Material, the Chief of Naval Personnel and the Chief, Bureau of Medicine and Surgery.

B. THE NAVAL MATERIAL COMMAND

The concept of the Naval Material Command is that of a single, integrated material support agency under the Chief of Naval Operations with central responsibility and accountability for depot maintenance, facility support, and integrated logistic support planning. The Chief of Naval Material commands the Naval Material Command and is tasked by the Chief of Naval Operations to:

> 1. Meet the total system and material support needs of the Operating Forces of the Navy for equipment, weapons and weapon systems, materials, supplies, facilities, maintenance, and supporting services including the development, acquisition, procurement, construction, maintenance, alteration, repair, and overhaul of ships, aircraft, surface and undersea craft, space and oceanographic systems, and equipment; training equipment; fixed ocean systems; and shore facilities and utilities, all consistent with approved programs.
> 2. Respond directly to the Commandant of the Marine Corps in meeting those particular support needs of the Marine Corps which are required to be provided by the Naval Material Command.
> 3. Respond to the heads of other Department of Defense and Department of the Navy organizations in meeting their material support needs (including those of the Naval Reserve) that are provided by the Naval Material Command. [Ref. 9, p. 1, Encl. 1]

The Naval Material Command is organized in the staff and line pattern as shown in Appendix A. The staff component is the Headquarters Naval Material Command and the line

components are the Systems Commands, the Project Managers, and the Naval Material Command Centers/Laboratories. The Systems Commands are: Naval Air Systems Command, Naval Electronic Systems Command, Naval Facilities Engineering Command, Naval Sea Systems Command, Naval Supply Systems Command [Ref. 39, p. I-1].

C. THE MAJOR CLAIMANTS

The operational chain of command leads from CNO to the activity through the "Major Claimant" which is a headquarters component. A major claimant is a bureau/office/command/Headquarters, Marine Corps, which is designated as an administering office under the operation and maintenance appropriations. Navy major claimants receive operating budgets directly from the Chief of Naval Operations, Fiscal Management Division (OP-92). The headquarters components who are major claimants to the Operation and Maintenance, Navy (O&MN) appropriation are [Ref. 27, p. 111]:

1. The Office of the Comptroller
2. The Office of the Chief of Naval Operations
3. The Office of the Oceanographer of the Navy
4. The Bureau of Naval Personnel
5. The Bureau of Medicine and Surgery
6. Chief of Naval Material
7. The Chief of Naval Education and Training
8. The Naval Telecommunication, Intelligence, Weather Service and Security Group Commands
9. Commander-in-Chief Atlantic Fleet

10. Commander-in-Chief Pacific Fleet

11. Commander-in-Chief Naval Forces Europe

It is noted that the Chief of Naval Material is the major claimant for the Systems Commands for O&MN funds.

D. THE NAVAL FACILITIES ENGINEERING COMMAND

The Chief of Civil Engineers, under the command of the Chief of Naval Material, commands the Naval Facilities Engineering Command. The Naval Facilities Engineering Command (NAVFAC) is tasked to provide support to the Chief of Naval Operations, the Operating Forces of the Navy, the Marine Corps, and components of the Naval Material Command, and other offices and organizations in regard to shore facilities and related engineering, material and equipment [Ref. 39, p. III-13].

The responsibilities assigned to NAVFAC by higher authority cover a range of functions and are generally oriented towards material and technical support, and advice and assistance of an engineering nature. They carry out these responsibilities through a system of program management. The programs are:

I. Research

II. Planning and Real Estate

III. Engineering

IV. Construction

V. Military Construction Programming

VI. Seabees

VIII. Family Housing

IX. Public Works

X. Administration

Program management is carried out through six Engineering Field Divisions (EFDs), three Construction Battalion Centers (CBCs), and nine Public Works Centers (PWCs). The Engineering Field Divisions are responsible for the accomplishment of NAVFAC objectives and programs related to the shore establishment within the EFD's geographical area of responsibility. The NAVFAC program directly relating to maintenance of facilities and this thesis is Program IX, Public Works.

Management by programs is designed to concentrate attention, capability and resources on each area of mission responsibility, and to provide an orderly means of establishing priorities, allocating resources and evaluating performance. The program structure serves as a management tool to facilitate goal assignment, budget assessment and allocation, responsibility assignment, and progress and efficiency evaluation. (These management programs differ from budget programs (budget activities) which are discussed later.)

The fundamental mission of an EFD regarding the Public Works management program includes: the accomplishment of planning; design and construction of public works and public utilities; disposal of Navy real estate; advice and assistance in the administration of facilities management of resources; [Ref. 37, p. 1] direction and administration of the assignment, replacement, disposal, maintenance and utilization of transportation, weight handling and construction equipment and collateral support equipment [Ref. 40, p. 8-9). These

mission elements are administered at the EFD level by its Facilities Management Department which is the source through which the shore activities obtain technical guidance.

E. THE SHORE ESTABLISHMENT

The Shore Establishment of the Department of the Navy consists of numerous naval shore activities within the United States and throughout the world. These activities are classified by types and perform varied assigned functions and missions in support of the Operating Forces. The specific missions of each shore activity are approved by SECNAV as proposed and developed by the Chief of Naval Operations [Ref. 51, p. 1].

The naval shore activities generally follow similar lines of organization and operation. Each naval activity is usually organized with a Commanding Officer (CO) or Officer-in-Charge (OIC) and several functional department heads. Some departments act in a line capacity to the CO in direct support of the activity's mission while other indirect departments support the direct mission departments. The Public Works Department is an example of an indirect department. The department heads operate under the delegated authority of the Commanding Officer and are responsible for compliance with regulations governing the utilization of public monies and materials, and the implementation of improved management techniques and procedures [Ref. 51, p. 13].

F. THE PUBLIC WORKS DEPARTMENT

The Public Works Department can be an organizational component of a Marine Corps Air Station or a Naval Shore Activity [Ref. 40, p. 2-7]. The Public Works Officer (PWO) is held accountable by the Commanding Officer for all facilities management matters. These responsibilities normally include the broad functions of:

1. Facilities Planning and Programming
2. Real Estate Management
3. Facility Design and Construction
4. Facilities Maintenance, Repair, Minor Construction, Alteration and Equipment Installation
5. Utilities System Operation and Maintenance
6. Facility Disposal
7. Transportation Fleet Management Operation and Maintenance
8. Housing Administration

The primary purpose of a Public Works Department is to provide a service in support of the mission of the activity. Operations are expressed in terms of resources required and are organized along functional lines for the effective application of resources. The basic elements found in most Public Works organizations are: Management, Administration, Family Housing, Engineering, Maintenance Control, and Production [Ref. 40, p. 2-7].

To aid in the management of the resources necessary in the performance of the Public Works Department's mission, a standard PWD organization has been developed as shown in

Appendix B. This PWD organization is composed of seven divisions, four of which support the overhead subfunctions of the department and three which support the production subfunction.

The Administrative Division is responsible for all matters pertaining to organization, methods, procedures, work flow, work measurement, civilian personnel, office services, reproduction, reports, statistics, budget and finance [Ref. 40, p. 2-14].

The Housing Division is responsible for housing administration, and through liaison with other divisions of the Public Works Department, arranges for inspection, planning and estimating, and performance of maintenance of housing [Ref. 40, p. 2-15].

The Engineering Division is responsible for all matters pertaining to engineering studies and reports, including preliminary designs and estimates for special repair and improvement projects, engineering design and the maintenance of technical plan files and records. The division is also responsible for the Shore Facilities Planning and Programming documents and for the submission of basic data required for preliminary engineering studies, such as environmental impact analyses and project economic analyses [Ref. 40, p. 2-15].

The Maintenance Control Division is responsible for the integration of a short and long range maintenance plan and workload program and the inspection, planning and estimating and scheduling work for the production divisions [Ref. 40, p. 2-16].

The Production Divisions of Maintenance, Utilities and Transportation are respectively responsible for: maintenance of all public works and public utilities, operation of utility plants and distribution systems, and providing transportation and equipment services to all components of the activity. These three divisions compose the direct labor personnel of the department.

Public Works Departments vary greatly as to size of the total organization. The staffing of the organization and the size of each individual division depends on the type and amount of work to be done, the amount of plant to be maintained, the number of utilities to be provided and the transportation services to be provided. [Ref. 40, p. 2-8].

III. FINANCIAL MANAGEMENT IN PUBLIC WORKS

A. BUDGETING

The previous chapter discussed the organizational hierarchy in the Navy as it relates to a Public Works Department of a naval shore activity. This chapter will relate financial management to that chain of command, particularly that of the budget process. The budget is the basic financial plan from which all financial management evolves and can be considered the master plan for an organization's financial management.

Budget proposals are sent up the chain of command for approval and, when approved, are sent back down the chain of command for spending by the originating organization. These processes are termed budget formulation and budget execution in the Navy and will be discussed in greater detail in this chapter.

This chapter will also separate capital budgets from operating budgets as they apply to a Public Works Officer and will explain the Planning, Programming, Budgeting System (PPBS) used in the Department of Defense. Accounting will also be discussed to relate the financial responsibility associated with the Public Works Officer's billet.

1. Capital Budgets vs. Annual Operating Budgets.

There is a fundamental distinction between a PWO's "capital budget" and his annual operating budget. The distinction between the two types of budgeting is more clear in the private sector where the type of budgeting generally

considers different sources of funds. The distinction also exists in the Navy, but the term "capital budget" is seldom used and capital budgeting is not done in the same way as in the private sector. But to the PWO at the activity level, the distinction is real. His annual operating budget is his portion of the activity's annual budget which consists of the resources required throughout the year for the performance of the activity's mission in financial terms. In general, the source of funds of the annual operating budget of a naval shore activity is the O&MN appropriation. His "capital budget" consists of investments or capital assets that the activity requests from higher authority and is not from the activity's annually appropriated budget. Examples are procurement of real estate, military construction, automotive vehicles and construction support equipment.

The chain of command for budget action is different for these two types of budgeting. This thesis is limited to the annual operating budget aspects of the PWO's financial management where the chain of command is from the activity, through the major claimant, CNO, SECNAV, SECDEF, The President, and The Congress.

2. Other Fund Sources.

The Navy has grouped Public Works functions into Facilities Management functions and Family Housing functions. Facilities Management functions at most activities are funded from the Operations and Maintenance, Navy (O&MN) appropriation. Family Housing functions at all activities are funded from the Defense Family Housing Management Account (FHMA) as a part

of the Military Construction Appropriation. Budgeting for Family Housing is accomplished through another funding chain of command with a different set of rules including different formats and a different budget cycle. This thesis will not consider Family Housing management specifically; and, although the regulations governing the management of Family Housing are different than Facilities Management (or Maintenance Management), there also are similarities.

Reimbursable funds are also frequently generated by the Public Works Department when providing support to tenant activities. Technical equipment is budgeted for in a separate budget and funded under the Other Procurement, Navy Appropriation (OPN). Other funding could be provided by still another appropriation, depending on the special circumstances at any particular activity. Funds provided by these other sources are generally a relatively minor portion of the Public Works Officer's budget and are considered to be atypical, so they are not within the scope of this thesis.

3. Planning, Programming and Budget System.

The Department of Defense Planning, Programming and Budgeting System (PPBS) is the normal process wherein Secretary of the Navy and Secretary of Defense decisions are made to determine force levels, weapon systems and support programs. PPBS is one of the Resource Management Systems (RMS) also discussed in Chapter V. The procedures within the PPBS can be summarized as follows:

> Strategy is developed in consideration of the threat and policy. Force objectives are

> developed to support the strategy. Programs are developed to provide, on an orderly basis, ships, aircraft, weapons systems and manpower over a period of time, with due consideration of the total cost to the nation. Lastly, funds are budgeted in such a manner as to obtain the forces and weapon systems within the resources that the Congress provides. [Ref. 45, p. I-2]

Planning, the first phase of the PPBS, starts with the assessment of the threat to the security of the United States and, when combined with national policy, culminates in the development of force objectives to assure the security of the United States.

The basic purpose of the programming phase is to translate Department of the Navy approved concepts and objectives into a definitive structure expressed in terms of time-phased resource requirements including personnel, monies and material. This is accomplished through systematic approval procedures that express the cost of force objectives for financial and manpower resources five years into the future, while at the same time displaying forces for an additional three years. This gives SECDEF and the President an idea of the impact that present day decisions have on the future defense posture.

The budget process is the final phase in the PPBS cycle. The annual budget expresses the financial requirements necessary to support the approved Navy programs which were developed during the planning and programming phases. It is through the budget that plans and programs are translated in annual funding requirements. Each year's budget estimate sets forth precisely what the Department of the Navy expects to accomplish with the resources requested for that year.

The Five Year Defense Program (FYDP) is a list of programs that are the responsibility of the Secretary of Defense from which the annual DOD budgets are developed. The Department of the Navy has a similar listing, the Department of the Navy Five Year Program (DNFYP), which lists those programs that are the responsibility of the Secretary of the Navy and is the Navy's portion of the FYDP. This subcategorization loses its effectiveness, though, the further one goes down the chain of command. For instance, the Public Works Officer's budget at a shore activity is a relatively insignificant portion of one of the ten FYDP programs. The program under which his activity is categorized represents an objective that is too abstract for him to prepare a detailed operating budget.

The PPBS programs are broken down into FYDP programs (and DNFYP), program elements, functional categories and subfunctional categories and it might appear that everyone at each level of management develops their own programs from their own strategic plans. This does not actually happen though, because sooner or later in nearly every organization, an operating level of management is reached where very few, if any, strategic plans are developed. PPBS is an effective management tool for top level management, but it is not as applicable to lower levels of management. It is contended that PPBS does not provide an effective means of budgeting for lower levels of management, especially at an operating level of management where strategic decisions are essentially nonexistent.

The poor correlation between PPBS programs and the Public Works Officer's budget can also be illustrated by looking at the breakdown in each category. The major programs used in the FYDP are as follows [Ref. 27, p. 56]:

1. Strategic Forces
2. General Purpose Forces
3. Intelligence and Communications
4. Aircraft and Sealift
5. Guard and Reserve Forces
6. Research and Development
7. Central Supply and Maintenance
8. Training Medical and Other General Personnel Activities
9. Administration and Associated Activities
10. Support of Other Nations

As an example, consider a naval shore activity that is a homeport for part of the fleet. This base would be part of FYDP Program 2, General Purpose Forces.

Each major program is subdivided into program elements which are the smallest unit of military output controlled at the DOD level. A program element is a combination of men, equipment, and facilities which together constitute an identifiable military capability or support activity [Ref. 27, p. 72]. There are several hundred program elements, too numerous to list here, but a few are listed from Program 2 as follows [Ref. 45, pp. 2-9]:

Element Code	Title
2 46 0	Support Forces - Shore-Based
2 46 1	Base Operations
2 46 11 N	Sea Control/Projection Air Base Operations
2 46 12 N	Sea Control/Projection Air Base Communications
2 46 13 N	Sea Control Air Base Operations

Element Code	Title
2 46 14 N	Sea Control Air Base Communications
2 46 15 N	Fleet Support (Port) Base Operations

Continuing with the example from above, this naval base would have program element 2 46 15 N. Generally, each DOD activity falls within one and only one program element and a naval shore activity would generally be assigned one and only one program element.

Functional categories are the first subordinate classification below the FYDP program element and they represent a grouping of operations or tasks related to the performance of a particular function. There are 12 functional categories which are listed with their reporting codes as follows [Ref. 27, p. 217]:

	Functional Categories	Codes
1.	Mission Operations	A,B,C,X
2.	Administration	D
3.	Supply Operations	E
4.	Maintenance of Material	F,G
5.	Property Disposal	H
6.	Medical Operations	J
7.	Base Services	L
8.	Maintenance of Real Property	M
9.	Utility Operations	N
10.	Other Engineering Support	P
11.	Minor Construction	R
12.	Personnel Support	S

It can be seen from examining these lists of programs, program elements and functional categories that the PPBS program concept does not continue into the functional categories. The naval base in the previous example might utilize several of the functional categories, and if it is a large base, it

might utilize all of the functional categories. This use of functional categories is typical for most naval shore activities, regardless of the applicable program element. Functional categories have been developed for the accounting system to identify why resources are being consumed. They are a breakdown of program elements, but they apply broadly to each program element and are not a specific breakdown of a specific program element. There is no correlation between an aggregate functional category and a specific program element. Therefore, the Public Works Officer is not involved in PPBS programming, that is, in developing PPBS programs, and he uses this sytem to budget only in a remote sense.

A similar evaluation of PPBS is also expressed by Peter Phyrr in his book on Zero-Base Budgeting.

> PPB is aimed primarily at macroeconomic analysis of broad policy decisions and desired output rather than the nuts and bolts of detailed planning and implementation, and therefore relates most directly to long range planning in industry.
>
> PPB does not provide an operating tool for the line managers who implement policy and programs and hence does not utilize this huge management resource below the top level whose actions have such a significant impact on both program effectiveness and efficiency. PPB has involved more top agency officials in planning and budgeting. But what about all the managers below this top level who implement the policy decisions? They either get handed a budget or they vie amoung themselves for the largest piece they can get of a predetermined budget figure calculated in the PPB process. These managers are not required to evaluate their operations, have no incentive to be cost effective, and have little satisfaction from actively participating in policy decisions and budget determination. [Ref. 42, p. 142]

This discussion of PPBS is made to help explain what the authors consider to be a management dilemma for the Public Works Officer. He does not have an effective financial plan by program with which to manage his organization. The next section of this chapter discusses more specific procedures of the formulation of the annual operating budget.

4. Formulation.

"Formulation" is the term used to identify that part of the budget cycle which includes all actions performed in the development of the estimates, the review of the estimates by command and technical echelons, and which culminates in congressional action. This culmination is the enactment of the various Department of the Navy appropriations in the DOD Appropriation Acts.

a. Budgeting in the Navy.

The Secretary of Defense promulgates the overall policies, pricing assumptions, and guidelines which govern the preparation of the annual budget in the DOD. The Department of the Navy's budget estimates, after approval of the Secretary of the Navy, are submitted to the Secretary of Defense, who determines the final budget estimates for the DOD for submission to the President for presentation to the Congress [Ref. 11, p. 3-2].

The Budget and Accounting Act of 1921 requires the President to submit to the Congress the annual Federal budget. This budget is made up of the annual estimates of all government agencies, including DOD. The Department of Defense budget is made up of the annual estimates of the

Departments of the Army, Navy, and Air Force. This chain continues downward in the Navy through the major claimants and the naval shore activities. Annual budget estimates, then, at any particular level are an aggregate of the subunits' budget estimates. This is also true at the activity level where the aggregate of the estimates from each of the departments becomes the budget estimate for the activity itself.

b. Budgeting at the Activity Level

The Commanding Officer of a shore activity issues an annual budget call to each of his departments requesting operating budget estimates and supporting data. The budget call promulgates policy, instructions and guidance that have come down through the command channels through the major claimant. The activity's comptroller summarizes the budget estimate from each department and prepares the finished form for submission to the major claimant.

Figures in the budget estimate at the departmental level are typically broken down into subfunctional categories. These are later aggregated in functional categories, program elements, and programs at higher levels of management in accordance with the PPBS concept. Typical subfunctional categories for a Public Works Department are [Ref. 40, pp. 13-17]:

LA Telephones
L7 Transportation
M1 Recurring Maintenance
N1 Utilities
P1 Other Engineering Support
R1 Minor Construction

Subfunctional categories are further broken down into cost account codes, which are four digit numeric or

alphanumeric codes used to classify transactions according to their purpose and are designed to provide a detailed breakdown on where resources are being used as illustrated in Appendix C. Major claimants and operating budget grantors have the responsibility to provide guidance as to the level of detail to be reported and may or may not require that the budget request be broken down into cost account codes. The expense associated with a specific cost account code is also identified with a specific expense element, which is an additional breakdown of the same funds for other reporting requirements. The expense element identifies expenses as to their type. More than one expense element could conceivably occur under a given subfunctional category. There are twenty-four expense element codes and they each consist of one alpha character [Ref. 12, pp. 4-240, 241].

The subfunctional category "M1 - Recurring Maintenance" is subdivided into cost account codes like [Ref. 12, pp. 4-428 to 4-452]:

7100	Buildings
7110	Training Buildings
71A0	Bachelor Officer Quarters
71B0	Family Housing, Routine Maintenance
7200	Waterfront
7210	Wharves
7220	Piers
7320	Airfield Runways
75M0	Maintenance of Antennas and Systems
7600	Utility Plants

These codes are entered on the NAVCOMPT Form 2168 - Operating Budget/Expense Report - which serves as the budget estimate submittal. Similarly, the cost account codes are identified with expense elements as described in Ref. 12. Typical expense elements identified with the M1 Recurring Maintenance portion of the budget are [Ref. 12, pp. 4-240 to 4-241]:

M	Utilities and Rents
N	Purchased Equipment Maintenance (Commercial)
Q	Purchased Services, Other
T	Supplies

The aggregation of the cost by expense elements are then listed by functional categories on NAVCOMPT FORM 2179-1, Activity Budget/Apportionment Submission. The two budget documents are developed for submission to higher authority. At the Naval Postgraduate School, the budget is broken down by both cost account codes and expense elements for submission to its major claimant.

The M1 subfunctional category represents the Public Works Officer's financial plan for maintenance. This portion of the budget estimate might be represented by a single lump sum figure with very little breakdown or additional supporting data. The Annual Inspection Summary (AIS) is used to project maintenance requirements into the future for budgeting purposes.

An effective maintenance management system relies on continuous inspection to generate work input. The Annual Inspection Summary (AIS) is a product of continuous inspection

and lists deficiencies in buildings, structures, and real property facilities. The AIS reports unfunded facilities deficiencies as of 31 December that require correction during the current fiscal year. The AIS is submitted to NAVFAC with copies to the appropriate EFD, the major claimant, and the Commandant of the Naval District [Ref. 29, p. 5-3]. While it is not a request for funds or a part of the budget submittal, it does provide supporting data to the budget estimate. The AIS is a mid-year status report that lists work that needs to be done during the remainder of the year for which funds are not available.

The Backlog of Maintenance and Repair (BMAR) is similar to the Annual Inspection Summary (AIS) in that it is a result of the continuous inspection program. Where the AIS lists required, unfunded, and current fiscal year maintenance deficiencies as of 31 December, the BMAR is a total list of all known deficiencies at the close of the fiscal year. Initially, the facility involved may continue to perform its designated purpose; however, with time and the continuous lack of maintenance, progressive deterioration begins to restrict the utilization of the facility. As this condition approaches, the maintenance and repair items for a single facility are, or can be, totalled and submitted to the major claimant in the form of a special maintenance or repair project.

5. Execution.

"Execution" is the process of obligating and expending congressionally appropriated funds for the current and

prior fiscal years. An appropriation is an authorization by an Act of Congress to incur obligations for specified purposes and to make payments for these obligations out of the Treasury. Budget execution is that phase of the budget cycle which encompasses all the actions required to accomplish effectively, efficiently and economically the programs for which funds were requested and approved by Congress. Effective budget execution requires procedures for control and evaluation which will ensure compliance with regulations and limitations established by the Congress and other echelons of responsibility and command within the government and the Department of the Navy [Ref. 14, p. 3-1].

Execution covers a long period of time and involves a large number of people. Execution of the annual operating budget begins on the first day of the fiscal year and continues throughout the fiscal year. Annual appropriations normally lapse, for purposes of expenditure, three years after the date the funds become available for obligation; so the procedure is continuous over a long period of time. The entire Department of the Navy is involved in the execution process whereas only a few people were involved in the formulation process. In a Public Works Department, the Public Works Officer, his division heads and some of the accounting staff in the Administrative Division were involved in preparing the budget estimate. In executing the budget, everyone on the payroll is involved by virtue of being on the payroll and creating an obligation by providing labor. Also, many people are involved in material procurement and usage of material

besides the management and administrative personnel that formulated the budget plan. All levels of management are concerned with and responsible for the correct expenditure of funds.

There are other, more significant differences between budget formulation and budget execution that will be further discussed in this section. The PPBS system of arraying the budget estimate into programs is a relatively new system compared to the appropriation breakdown with which Congress is familiar. The budget is actually submitted to Congress in both the traditional appropriation format and the new PPBS format. Congress appropriates funds, however, only in the appropriation format where the major categories are as follows:

a. Research, Development, Test and Evaluation (RDT&E)

b. Military Personnel (MILPERS)

c. Military Construction (MILCON)

d. Operation and Maintenance (O&MN)

e. Procurement (APN, SCN, OPN, WPN)

These categories can be viewed in a matrix with the ten major programs in the Planning, Programming, Budgeting System. Conceivably, a program element could receive funds from all of the appropriations.

There are confusing sets of procedures at various levels of command in the flow of funds downward to the using activity. Much of the confusion stems from the process of dividing up the appropriations into coded elements for the accounting procedures. The important feature of the present financial systems as shown at the Naval Postgraduate School,

for instance, is that the Public Works Officer eventually receives an operating budget that is in the same format and in the same breakdown as the budget estimate submittal.

An Appropriation Act by Congress does not automatically grant authority to obligate funds in the amount of the appropriation. An apportionment is required which is a determination as to the amount of obligations which may be incurred during a specified period under an appropriation. It provides for the systematic and orderly release of appropriated funds with respect to time. Annual appropriations are usually apportioned on a quarterly basis [Ref. 27, p. 129]. The Office of Management and Budget (OMB) approves apportionment requests and they are sent down the chain of command to the Chief of Naval Operations (CNO).

An allocation is the first subdivision of an apportionment [Ref. 45, p. 4B-1]. An allocation limits the total amount of appropriated funds that may be obligated for a particular budget activity or program during the fiscal year. Allocations are a control device to assure that the limitations of appropriations are not exceeded and they are generally structured in the same program structure used in formulating the budget. CNO allocates funds to offices, bureaus or systems commands for execution. The Director, CNO Fiscal Management Division (OP-92), is the "responsible office" for all Navy appropriations, except RDT&E.

OP-92 issues operating budgets, which are the means of issuing funds under the O&MN appropriation, to major claimants. As defined in Chapter II, a major claimant is a bureau, office

or command designated as an administering office under the O&MN appropriation and receiving an operating budget directly from the CNO Fiscal Management Division. Major claimants grant themselves operating budgets for centrally managed items and issue operating budgets to the naval shore activities under their command. The naval shore activity in this case is generally referred to as a "responsibility center" in Navy financial terms. A department or division of the activity is called a "cost center" and is defined as an organization entity for which the accumulation of costs is desired and which is controlled by one responsible supervisor. For the purpose of this thesis, a Public Works Department is a cost center and the command to which it belongs is a responsibility center.

Operating budgets are not broken down into the same detail required for formulating the budget estimates. They are broken down by quarterly increments of the "new obligational authority" and additions to the new obligational authority for military personnel expenses and changes in unfilled orders. Generally, the activity comptroller breaks down the operating budget into an operating target (OPTAR) for the departments or divisions in the command. It is further broken down into subfunctional category codes for the Public Works Department at the Naval Postgraduate School.

At the Public Works cost center, the approved operating budget is not necessarily in the same amount as the original budget estimate, but the total is broken down into subfunctional categories just as the budget estimate. This is true because Congress does not necessarily approve the budget

in the same amount as requested. The effect of apportionment is also carried down through the chain of command to the cost center where the execution of the annual budget is limited by quarterly increments.

B. ACCOUNTING

Accounting is the system used in setting up and auditing accounts to furnish a reckoning of resources (in monetary terms) received and used. It focuses on the measurement and reporting of the flow of resources into and out of the organization, of the resources controlled by the organization, and of the claims against those resources. Accounting serves the user of its information in three basic ways. First, it provides information that is helpful in making decisions. Second, it reports what happened after a decision was made. Third, it keeps track of a wide range of items to meet the scorekeeping and safeguarding responsibilities imposed on the organization [Ref. 53, pp. 3-4]. At a shore activity, accounting is normally performed by the activity's comptroller or by another activity designated as the Authorization Accounting Activity (AAA). Regardless of where the accounting function is performed, the activity commanding officer is responsible for the funds entrusted to his use.

An approved operating budget is received at an activity informing the commanding officer of the total resources available to carry out the activity's mission. The comptroller, acting for and with the commanding officer's authority, then establishes a job order structure to delegate obligational authority to the various cost centers of the activity. The

job order system is a control device and is designed to allow collection of information in a form useful to local management and to allow summarization for higher levels of authority.

The Comptroller of the Navy provides the following information concerning an activity's job order structure:

> Activities accounting for operating budgets will develop a job order structure to provide for the accumulation of accrued expenses. The term "job order structure" will include any assignment of codes for the purpose of accumulating and posting accounting information. A Navy-wide job order structure is not prescribed because of the variation in requirements, however, the locally prescribed structure must be designed to produce accrued costs at the budget classification level, functional category level, subfunctional category level, cost account level, and when such information is not derived by other methods, the expense element level. The job order structure must be so designed that other required cost reporting can be obtained. In addition, the job order structure must provide details at any level desired by local management. Activities that are supported by another activity for accounting services should be governed by instructions issued by that activity pertaining to job order structure, coding, data submission schedules, and other factors which require standardization for mechanized systems and effective operation. [Ref. 50, pp. 4-7]

As the annual job order structure is being developed, the Public Works Officer must decide what cost information to accumulate and convince the fiscal officer, comptroller, of his needs. Realistically, the larger the job order structure the more error prone and expensive it becomes; however, it provides additional management flexibility for the Public Works Officer.

The NAVCOMPT Manual assigns the accounting responsibilities to the comptroller department or fiscal office of the activity and states that the Public Works cost accounting procedures

are designed to "require a minimum of clerical effort within the Public Works Department which effort should be limited to the generation of basic cost and statistical data." [Ref. 13, p. 7-3]. Typically, the official accountant is an assigned Authorization Accounting Activity (AAA) and the local comptroller maintains memorandum accounts and provides feeder information to the AAA. The Public Works Officer is responsible to insure the proper use and control of the operating budgets assigned to the Public Works Department. His activities of control should not duplicate those of the comptroller but should focus on funds availability and the proper use of accounting data.

Under the concepts of Resource Management Systems (RMS), Project Prime is the name associated with the preparation and implementation of the systems for management of resources for operating activities. Project Prime sought to modify programming, budgeting and accounting procedures so they would be more useful and to permit the use of operating budgets as the main tool for managing consumable resources of the Department of Defense. The chief elements of Prime were: (1) a concern with operating resources as contrasted with capital (investment) resources; (2) an integrated structure for programming, budgeting and management accounting; (3) to focus on expense and the total cost; and (4) to assist operating managers. [Ref. 27, p. 45]. Operating accounts were established, programs developed, budgets prepared, and reports made using the same basic structure of the FYDP.

Prime accounting operates on the basis that an activity be charged with all operating resources which they consume and that the reporting procedure be integrated so budgeting and accounting information will track FYDP programming. The expense account structure was tied to the basic program element, budget classification, functional/subfunctional category, and elements of expense. The Prime accounting reports are discussed in Chapter V. These reports are generally automated and provided by the Authorization Accounting Activity. At the Naval Postgraduate School, the comptroller additionally provides a manually prepared Status of Operating Target report on a monthly basis. This report provides the cost center manager with information on funds authorized, funds committed, fund balance and the last obligation document included by subfunctional categories as of a particular date.

IV. MAINTENANCE MANAGEMENT SYSTEM

Financial management in the Public Works Department, as discussed in Chapter III, suggests the need for a better understanding of maintenance management in Public Works. NAVFAC has provided a system for the management of maintenance in the "Maintenance Management of Public Works and Public Utilities," MO-321 [Ref. 30]. The system is viewed in phases consisting of planning, execution and appraisal. In production terms, the process could be viewed as input, output, and appraisal, because planning actually consists of work identification, work input control and planning and estimating.

A. MAINTENANCE PLANNING

Work identification is the initial step in the operation of the system where facility and equipment deficiencies are identified. The identification of deficiencies is accomplished through a continuous inspection program in which Public Works Department personnel perform inspections of facilities on a regularly scheduled basis. Deficiencies are identified against a predetermined level of maintenance standard for each facility and item of equipment. Additional maintenance deficiencies are identified by personnel outside the Public Works Department inspection organization and are brought to Public Works attention through requests for maintenance service by other departments in the activity and through official inspection reports of the command.

Work input control is a decision process performed by the Maintenance Control Division. Many factors affect this decision-making process such as the legality of the work, the relative urgency of the work and the approval authority required before proceeding with the work. Once it has been decided to proceed with the work, it is classified by the size of the job. Basically, there are three sizes of jobs which are called emergency/service work, minor work, and specific job order work. Emergency work is self-descriptive and is limited to two man-days of effort. A job that is seen to exceed this limitation must be superseded by a minor work authorization or a specific job order. Service work is also limited to two man-days of effort and for this reason is categorized with emergency work. Costs for emergency/service work are normally collected under a standing job order.

Minor work authorizations are written for jobs that will exceed two man-days but that will not exceed five man-days of effort. Costs are not collected on individual minor jobs but are accumulated against a standing job order for each appropriate functional or cost account [Ref. 30, p. 3-1]. From the authors' experience, the upper limit of minor work is often lowered, sometimes to the extent of completely eliminating this category. The fact that costs are not collected on individual minor jobs contributes to the practice of reducing or eliminating this category and substituting a specific job order.

The only remaining size category is specific job orders that have a lower limit of five man-days or are in excess of

the cut-off point for minor work, whichever is less. Costs are collected for individual specific job orders and for this reason there are situations where all work is classified and written up as a specific job order. Reimbursable work and work on married officer's quarters could be classified as specific job order work and would be so classified for accounting and financial evaluation purposes.

Other decisions required in the work input control process are the method of accomplishment and the funding required to accomplish the work. Some work may be beyond the capability of local shop forces, either because of lacking technical skills or because the volume is so great that it exceeds local capacity. Funds may or may not be available in the budget to accomplish the work and this factor alone often becomes an overbearing decision criteria.

Once maintenance deficiencies are identified and authorized, the work required to correct them is planned and estimated utilizing material and engineered performance standards. A job order is written from the estimate that describes the work for each work center (sub-cost center) and categorizes the estimated costs against which performance is later evaluated.

B. MAINTENANCE EXECUTION

The execution phase consists of scheduling and performing the work at the shop level. A monthly backlog of work is given to the shops by the Maintenance Control Division in a form that is called the Shop Load Plan. Shops scheduling is

a more detailed procedure that commits specific shop personnel to specific work in daily increments and is done on a weekly basis. Execution of work is accomplished by the various work centers in the Maintenance Division in accordance with the schedule developed by the shops scheduling process. Expenditure of labor resources against each job is recorded daily by the use of a time card and a labor distribution card and is later summarized in various financial and management reports.

C. MAINTENANCE APPRAISAL

Appraisal is a phase of the maintenance management system that is not structurally formalized although MO-321 suggests the periodic use of a published questionnaire to evaluate actual performance with plans [Ref. 30, p. 11-1]. Analysis of reports is considered important, too, in measuring the effectiveness of the maintenance effort. The reports that result from the Maintenance Management System are described in the next chapter.

V. CURRENT INFORMATION SYSTEMS

This chapter highlights current financial and managerial reports which are required by the Resources Management System, by Naval Facilities Engineering Command and by the Public Works Officer. The fact that the station comptroller is the fiscal officer and is responsible for financial reporting and control is emphasized. The usefulness of each report is briefly discussed.

A. RESOURCE MANAGEMENT SYSTEMS AT A NAVAL SHORE ACTIVITY

Resources Management Systems (RMS) are a series of systems designed to promote better management throughout the Department of Defense by providing managers with improved means of obtaining and controlling the resources required to accomplish missions. These systems include procedures for collecting and processing recurring, quantitative information that relates to resources and is for the use of management [Ref. 27, p. 40]. The four interrelated systems as developed by the military departments and defense agencies are [Ref. 13, p. 1-3]:

1. Programming and budgeting systems;

2. Systems for management of resources of operating activities;

3. Systems for management of inventory and similar assets; and

4. Systems for management of the acquisition, use, and disposition of capital assets.

This thesis is primarily concerned with the system for management of resources of operating activities. The objectives of management of resources of operating activities are the following [Ref. 13, p. 1-3]:

1. To provide managers at the responsibility center and subordinate levels a system which includes the monetary and quantitative information that will enable them to effectively and efficiently manage resources made available.

2. To furnish operating budget grantors and other levels of management up to and including the Navy Comptroller that degree of financial information necessary for effective coordination and control of resources.

3. To determine the cost of operation of an activity in terms of total resources consumed or applied.

The accomplishment of the above stated objectives are predicated on the five following criteria [Ref. 27, p. 43]:

1. Focus on outputs and on resources used.

2. Focus on managers who are responsible for effective and efficient use of resources.

3. Focus on actual performance in relation to planned performance.

4. Use expense operating budgets and accounting as aids in management control at each organization level.

5. Use working capital to hold resources in suspense, in both time and place, between the acquisition of resources and their consumption.

The result was an operating budget system designed to provide reports on financial and quantitative information to each

level of management beginning with the cost center. At the cost center manager and responsibility center manager levels, the reports enable the managers to study variances from planned to establish workload trends of efficiency and to more effectively use available resources. In essence, each manager has more flexibility in the use of assigned resources.

B. PUBLIC WORKS MANAGEMENT REPORTS

1. Comptroller Prepared Reports.

a. Resources Management Systems Reports.

Reporting is a form of responsibility accounting. Under the Resources Management Systems (RMS) for Operations, the Commanding Officer has at his disposal a number of management and financial reports. He uses some reports and forwards others to the echelon of management that granted his operating budget. Authority to approve an operating budget normally is vested in the major claimants or other Navy organizational components to which funds have been allocated for the purpose of providing support to the performing activity. The upward financial reports provide the data for the appropriation allocation accounting records and provide information on the performance of the activity.

The following reports are required

(1) Operating Budget Expense Report (NAVCOMPT Form 2168).

(2) Performance Statement (NAVCOMPT Form 2169).

(3) Expense Operating Budget Financial Report (NAVCOMPT Form 2170).

(4) Budget Classification/Functional Category/Expense Element Report (NAVCOMPT Form 2171).

(5) Military Services Report (NAVCOMPT Form 2182). Additional reporting to meet higher authority and local command needs are encouraged by the Comptroller of the Navy [Ref. 5, p. 6-1].

The Operating Budget/Expense Report actually consists of two reports: one a cost center report, the other a responsibility center report. The report provides management with monthly details as to work units, completed man-hours, and accrued expenses, cumulative to date by responsibility center and separately by each cost center. The data information for the report is obtained from the local job order accounting system [Ref. 27, p. 229].

The Performance Statement is prepared monthly for each cost center and responsibility center. This report is designed to compare the accrued expenses and work units completed with the center's budget of each related item. The comparison between actual and planned performance is presented in terms of percentage of the year's budget. This allows the manager to compare actual expense percentage with planned expenses so budget obligation rate can be evaluated [Ref. 27, p. 229].

A third report is the Expense Operating Budget Financial Report. This is a monthly report consisting of five major separate sections, designed to provide current status of the operating budget to the budget authority, which is normally the major claimant. The major sections of the report are the:

(1) Trial Balance Section

(2) Real Property Maintenance Section

(3) Military Services Applied Section

(4) Reimbursable Transactions Section

(5) Expense Operating Budget Changes Section

Provisions for the Analysis of Account 540 - Unfilled Orders and any additional information required by management are included in the reports [Ref. 27, p. 237].

The Budget Classification/Functional Category/Expense Element Report is prepared monthly for each operating budget holder. This report reflects data in budget terms by gross adjusted obligations and expenses incurred during the month of the report. The report is designed to provide input for cost information systems at the Department of the Navy level [Ref. 27, p. 237].

The fifth required report is the Military Service Report. It provides the monthly expense figure for military service that is to be charged to the operating budget [Ref. 27, p. 237].

These operating budget reports are forwarded to the claimant and other commands, activities or offices when the budget holder is specifically directed to do so. (The above reports are explained in detail in NAVSO P-3006-1.) [Ref. 50].

In addition to the above reports, the Naval Postgraduate School Comptroller manually provides a Status Operating Target (OPTAR) report. This OPTAR report provides status

on funds authorized and funds committed by subfunctional category by cost center on a monthly basis.

b. Public Works Management Reports.

The station comptroller plays a key role for Public Works as well as supporting the activity's commanding officer. The Navy Comptroller Manual states, "The performance of all cost accounting functions are provided as a service to the Public Works Department by the Comptroller Department or Fiscal Office." It further assigns the reporting responsibility for several principal Public Works reports to the Comptroller Department or Fiscal Office [Ref. 13, pp. 7-12]. The principal reports which are the comptroller's responsibility are:

(1) Transportation Cost Report (TCR).

(2) Tabulated Report A. Feeder report for the Maintenance and Utilities Labor Control Report (NAVFAC Form 9-11014/29).

(3) Tabulated Report B. Completed Job Orders.

(4) Maintenance Cost Report.

(5) Utilities Cost Analysis Report (NAVCOMPT Form 2127).

(6) Housing Cost Report.

As previously indicated, this thesis is only concerned with the Public Works maintenance financial system and, as such, will limit discussion to the Public Works maintenance related reports.

The Tabulated Report A is the feeder report for the Maintenance and Utilities Labor Control Report. It is a

monthly report and provides basic information on the expenditure of labor hours to the various labor class codes of work in each cost center. It is for local use only and is optional for small activities with less than seventy-five personnel in the combined maintenance and utilities division. Its primary use is a feeder in the preparation of the manpower availability summary [Ref. 13, p. 7-93].

The Tabulated Report B is a two part report designed to provide final cost data on completed job orders. Part one includes both completed and cancelled job orders and is prepared weekly at the option of the Public Works Officer. Part two includes only completed job orders and is prepared monthly. The report is optional for small activities. It is designed to evaluate both planning and estimating and job order execution by highlighting variances [Ref. 13, p. 7-93].

The Maintenance Cost Report is an annual report designed to obtain fiscal year cost data related to real property maintenance functions funded by appropriations other than 17-1804, Operation and Maintenance, Navy; 17-97-0700, Family Housing Management Account, Defense (Transfers to Navy) and those appropriations administered by the Commandant of the Marine Corps. The Maintenance Cost Report is prepared annually when required by higher authority [Ref. 13, p. 7-95].

2. Public Works Prepared Maintenance Reports

Public Works financial management reports are provided under the Resources Management Systems and are the responsibility of the Fiscal Office or Comptroller Department. Additionally, the responsibility for the Tabulated Report A and

Tabulated Report B are assigned to the Comptroller Department. These two reports are in turn used within the Public Works Department as source data for the "Maintenance/Utilities Labor Control Report" and the "Report on Variations on Completed Job Orders," respectively.

The Maintenance/Utilities Labor Control Report is normally prepared monthly by the Public Works Administration Division for use throughout the department. The report displays and compares actual labor expended by labor class code for each trade branch with planned man-hour expenditure for the branch for the month and year to date. It also summarizes labor expenditures for the combined Maintenance and Utilities Divisions. The report measures productive and overhead effort in man-hours and compares it with acceptable percentages of distribution for each labor class code [Ref. 40, p. 6-36].

The Tabulated Report B is used to highlight total job order variances. Using these variances and the established NAVFAC criteria, specific completed job orders are listed on the "Report on Variation on Completed Job Orders" to be investigated as to cause of variance. The variance analysis serves as a benchmark from which to judge the quality of planning and estimating and shop execution of the planned work [Ref. 40, p. 6-34]. Both the Maintenance and Utilities Labor Control Report and the Report on Variation on Completed Job Orders are local Public Works maintenance management reports.

Another maintenance management report which is manually prepared is the Annual Inspection Summary. This is an annual report which is prepared by the Maintenance Control

Division based on the results of the Continuous Inspection System. The report is submitted to NAVFAC and it identifies facilities maintenance deficiencies in dollar terms that are unfunded. It provides facilities condition information to assist the major claimant in the allocation of resources. Likewise, it provides data to the Office of the Secretary of Defense on the backlog of maintenance and repair work and serves as backup data for budget and special project requests [Ref. 40, p. 6-40]. A distinct disadvantage of the Annual Inspection Summary is that it lists deficiencies as of mid-year that are unfunded but that are required in that fiscal year. Activities may be using the AIS for various purposes, but it is required as an unfunded deficiencies list.

3. Other Reports and Information.

In addition to the above-mentioned reports, the Public Works Department is tasked to provide a myriad of operational, status and special interest reports to various echelons of management. The major portion of these reports are provided as required by the major claimant and/or the Naval Facilities Engineering Command (NAVFAC) or his representative Engineering Field Division (EFD). The major claimant is normally interested in such reports as: special projects, inventory of furniture, civil engineering support equipment, transportation and utility costs, utilization of military real property, utility accomplishment plan, and defense integrated management engineering system. NAVFAC or the EFD is normally interested in these types of reports: chloride, fluoride, boiler and potable water, pest control, pollution control, lease

renewal, elevator inspection, etc. The Public Works Department is frequently tasked with a special interest, one-time report.

VI. NAVAL FACILITIES SYSTEMS AND PUBLIC WORKS DEPARTMENT MANAGEMENT SYSTEM

This chapter reviews a portion of the Navy's approach to the management information question. It first presents in broad terms the Naval Facilities Engineering Command's Naval Facilities System (NFS). Ultimately, within the NFS family of systems, the Public Works Department Management Systems (PWDMS), partially published and partially in draft form, is presented in an objective manner. The Transportation and Utilities Modules of the PWDMS are limited to a scope statement.

A. NAVAL FACILITIES SYSTEM

OPNAVINST 5231.1, Implementation of Navy Integrated Command/Management Information Planning System, dated 2 July 1969, designated the Naval Facilities Engineering Command as the system proponent for the Naval Facilities System (NFS). Since 2 July 1969, the Naval Facilities Engineering Command has committed itself to reliance on automated information systems and has organized the Naval Facilities System (NFS). The Naval Facilities System organizationally consists of a Command/Management Information System (FAC-COM/MIS) and a group of uniform functional systems, each of which is a Automated Data System (ADS). The FAC-COM/MIS is designed to serve NAVFAC Headquarters and NAVFAC major commands, while the functional ADS has application in shore facilities planning and real estate, military construction programming, support for the Naval Construction Force (NCF), construction,

automotive and special equipment, Public Works Departments, environmental protection and family housing.

The Naval Facilities System is supported by seven fund sources and each ADS has functional management at the Assistant Commander's level at NAVFAC Headquarters. The ADS and their Headquarter system proponents are [Ref. 31, pp. 1-1 through 2-6]:

Automated Data System (ADS)	NAVFAC System Proponent
NAVFAC Headquarters (HD/MIS)	01
Engineering Field Division (EFD/MIS)	01
Construction Battalion Center (CDC/MIS)	06
Public Works Center (PWC/MIS)	10
Navy Facility Assets Data Base (NFADB)	20
Shore Facilities Planning (SFP/MIS)	20
Military Construction Programming (MCP/MIS)	21
Civil Engineering Support (CES/MIS)	06
Construction, Automotive & Special Equipment (CASE/MIS)	10/06
Public Works Department (PWD/MIS)	10
Environmental Quality Data System (EQDS)	10
Engineering Research System (ERS)	03
Family Housing (FH/MIS)	08

B. PUBLIC WORKS DEPARTMENT MANAGEMENT SYSTEM

The Public Works Department Management System (PWDMS) as a functional system within the Naval Facilities System (NFS) is designed to encompass all facilities management requirements at the activity level. It is of a modular design and ultimately will consist of six modules. The Emergency/Service module was published as NAVFAC P-428 in April 1975. The remaining modules of Continuous Inspection, Work Input Control, Management Analysis, Transportation and Utilities are at various stages of development and are to be published at later

dates. The published portion of NAVFAC P-428 provides for the above-mentioned six modules, while the drafts indicate that there would be three subsystems within the Public Works Department Management System. The subsystems were to be Maintenance, Utilities and Transportation subsystems. Each subsystem is to consist of various modules to meet the objectives and needs of that subsystem [Ref. 34, p. 1-1-3].

To date, the Introduction and Emergency/Service Module chapters have been published. The stated Public Works Department Management System objectives are as follows [Ref. 33, pp. 1-2]:

1. To provide a uniform mechanized method of inspecting, planning, and performing the public works functions at naval shore activities.

2. To provide the activity maintenance managers with the technical and routine information needed to effectively control the flow of manpower and financial resources needed to accomplish their mission.

These are the broad objectives for the total system and each module has its own specific objectives.

1. Emergency/Service Module.

It would be uneconomical and unnecessary to manage and control a five-hour service call with the same precision of a 250 man-hour repair job. Individually, the small service calls may not require an appreciable amount of resources; but, collectively, they constitute a sizable percentage of the total maintenance resources. Manual processing of this system may become entangled in the volume of transactions and not provide

management data on a continuous and uniform basis. This deficiency then impairs management's ability to manage and allows less than satisfactory utilization of resources.

The Emergency/Service Module is an effort to assist the maintenance manager in controlling emergency and service work from its reception to completion and analysis. Emergency work is work requiring immediate action to prevent loss or damage to government property, restore essential services of disrupted utilities, and/or the elimination of hazards to personnel or equipment. Service work is work that is minor in scope (not complicated), can be accomplished within two man-days of effort and does not exceed the locally established labor and material cost limitation [Ref. 33, p. 2-2]. The source document is the Emergency/Service Work Order with changes to adapt it for automatic data processing input.

The objective of the Emergency/Service Module is to assist the maintenance manager in the following ways:

a. Provide a simplified method to evaluate and analyze the work.

b. To identify requirements and control performance.

c. To forecast and plan manpower requirements.

d. To identify facilities and equipment requiring excessive breakdown maintenance.

e. To improve response time to emergency/service requests.

To help meet the stated objectives, the module design provides three management outputs for control, evaluation, and analysis of all work of this class. One output is the

Emergency/Service Outstanding Work Order Listing and it provides a summarized listing by work centers. A second output is the Emergency/Service Completed Work Order Listing and, in addition to the completed listing, it provides an analysis listing. The analysis listing displays areas where variation from standards are sufficient enough to warrant further investigation. The third output is the Emergency/Service Facility Listing which shows all man-hours expended for emergency/service requests by facility or equipment number by cost center.

The module assists management by processing and displaying data in a form which aids in the identification and magnitude of emergency/service work. It also assists management by identifying facilities and equipment which are requiring excessive amounts of emergency/service support.

2. Continuous Inspection Modules.

The inspection program serves as the base from which effective maintenance management begins. The Continuous Inspection Modules include standard procedures to identify deficiencies and to initiate appropriate corrective action designed to maintain facilities at a required level of maintenance. The Continuous Inspection Modules consist of the Preventive Maintenance and Control Inspection Modules. The two modules share common objectives except that the Control Inspection Module is concerned with all items of real property in addition to vital equipment. The facility and equipment numbers and established inspection frequency are the initial inputs from which inspection schedules are prepared for the fiscal year [Ref. 34, p. 1-6-3].

The objectives of the Continuous Inspection Modules are:

a. To provide scheduled examination of all items of real property and equipment.

b. To assure an adequate and consistent level of maintenance.

c. To provide a regulated input of essential work to the Maintenance Division.

d. To reduce the number of breakdowns and cost of repairs.

e. To detect and reduce overmaintenance [Ref. 34, pp. 1-6 - 3-57].

The Continuous Inspection Modules produce a combined total of fourteen reports. The Preventive Maintenance Inspection Reports consist of: inventory listing, inspection schedule, work orders, work order errors, omitted listing and performance report for vital equipment; while the Control Inspection Module reports are: proof and error listing, reference list, control inspections, schedule, work order, work order errors listing, omitted listing and accomplishment report for real property and equipment.

The major aid provided by the Continuous Inspection Modules is the display of total inspection requirements. This display allows the maintenance manager to provide scheduled work requirements for the inspector personnel. It serves as a tool to gauge the inspector coverage of real property and equipment. It also provides information for measuring the effectiveness of the Continuous Inspection programs.

3. Work Input Control Module.

The Work Input Control Module design concept is based on the establishment and maintenance of a comprehensive data base constructed around total workload requirements, fund resources, and manpower availability. The integration of these three factors provides the data required for the planning and accomplishment of facilities maintenance [Ref. 34, p. 1-2-2]. The module also provides the means for monitoring and controlling work as well as documenting its progress from identification to recording on history files. The draft manual states:

> This module provides for the total integration and simultaneous interface of all elements and related systems affecting the identification, planning, programming, accomplishment, and analysis of public works functions. [Ref. 34, p. 1-2-1]

There are nine management reports produced from data supplied to the Work Input Control Module when interfaced with other PWDMS modules. These reports provide for the identification of the total workload and reflect the current status of that work. These reports also monitor the utilization of available resources, performance, and error listings [Ref. 34, p. 1-2-106].

The major benefits to be derived from this module are worthy of note. The maintenance requirements and current status of these requirements are presented. The requirements are scheduled based on available resources and established criteria. It provides a long-range forecast of manpower and funding requirements and allows a consistent and uniform flow of work through the maintenance system. An additional benefit

is the reduced effort expended on clerical and routine management functions [Ref. 34, p. 1-2-4].

4. Management Analysis Module.

The maintenance management cycle would not be complete without an open feedback channel by which the accomplishment could be measured. The Management Analysis Module actually consists of a group of reports which serve this purpose. The module provides for the production of reports necessary in the analysis of completed work, work force distribution, and unfunded requirements. The information provided on actual costs facilitates better recordkeeping on the expenditure of funds and aids in assessing Maintenance Division performance.

The module's general objective is to provide Public Works management with sufficient data, displayed in a useful format, about maintenance accomplishment to allow recordkeeping as well as management by exception [Ref. 34, p. 1-4-1]. The reports are designed to provide comparative cost data (actual versus estimated) and to serve as a means by which customers can be kept informed on work status.

5. Transportation and Utilities Modules.

This thesis is primarily concerned with maintenance management and will restrict the Transportation and Utilities Modules discussion to a scope statement.

a. Transportation Module.

> The Transportation Management and Reporting Subsystem has been developed to assist local managers in acquiring a more efficient, economical, and responsive transportation equipment operation. The procedures provide for the mechanized preparation of

all internal and external reporting and are designed to obtain necessary cost and manhour information from the activity financial system. [Ref. 36, p. 1-1-1]

b. Utilities Subsystem Modules.

The Utilities Subsystem provides the manager with the tools necessary to effectively manage the utility plants and systems at an activity. It provides accurate and timely operation and maintenance information in the form of easily understood reports produced by three modules:

1. The Data Module provides information on the performance and the state of the utility system.

2. The Target Module provides information on the effectiveness of service utilization and operational efficiency.

3. The Allocations Module provides information on the extent a particular utility has been used by various customers. [Ref. 35, p. 1-1-1]

VII. MANAGEMENT INFORMATION SYSTEMS

The previous chapter discussed specific systems of management information within the Naval Facilities Engineering Command. The latter system, PWDMS, is specifically designed for Public Works management and, as such, is particularly relevant to this thesis. In analyzing this information system or any existing information systems, it is considered important first to subjectively examine information systems in general, which is the purpose of this chapter.

A. DEFINITIONS OF MANAGEMENT INFORMATION SYSTEMS

Many definitions of Management Information Systems (MIS) have been published and used by practitioners in the field of MIS. These authors, systems designers and systems users have not agreed upon a common definition of MIS though. It seems that people have attached meanings to this term to fit their situation, which may be an indication that management information systems are different for each different situation.

For the purpose of this thesis, information is regarded as processed data. The advent of electronic data processing and modern day computers has popularized this definition, but so be it; this is the environment as it exists. Data is a collection of numbers, letters, or symbols and is the input into the processing system. Information is the relevant knowledge produced as a result of data processing, whether it is done manually or by automated equipment. Generally, before

data is useful or meaningful, it must be processed into information. The goal of every MIS is to transform raw data into useful output information [Ref. 22, p. 30].

What is a MIS then? Some of the broad definitions found in the literature are as follows:

1. A system that economically provides the information needed for planning, direction, evaluation, coordination and control of the firm [Ref. 5, p. 58].

2. An organized method of providing each manager with all the data which he needs for decision, when he needs it, and in a form which aids his understanding and stimulates his action [Ref. 10, p. 59].

3. A means of providing to the people who need it, information to guide them in the conduct of business [Ref. 26, p. 609].

4. A medium for recording all significant actions of a company and logically assembling and screening them so they can be quickly interpreted and easily controlled [Ref. 4, p. 66].

5. A set of well-defined rules, practices and procedures by which men, equipment, or both are to operate on given input so as to generate information satisfying specifications derived from the needs of given individuals in a given business situation [Ref. 21, p. 16].

6. A system that supports managerial decision making by supplying relevant information when required [Ref. 20, p. 4].

7. A system that provides a manager with information on activities and pertinent interrelations about the current

status of the production/operation system over which he has authority [Ref. 1, p. 100].

The interpretations and definitions vary but they are consistent in stating the idea that a MIS provides information to aid the manager. They also infer that information should help the manager come to conclusions about the state of his business without a significant amount of searching or interpretation [Ref. 24, p. 38]. There are also varying degrees of what kind of information a manager needs, how much information the manager needs, when he needs the information, and why he needs the information. These in turn are based on the varying degrees of management being exercised. Obviously, a MIS should be designed for the managerial situation.

B. EVOLUTION OF MIS

The field of automated management information systems has evolved from transaction processing systems to total systems that will simulate the future and provide all possible information needs on all aspects of management. Early systems were characterized by batch processing business transaction data into compiled reports that simply did a clerk's job but did it faster. The latest systems are characterized by on-line processing, integrated data bases and sophisticated software programs that permit the user to obtain information directly from the data base and answer questions on subjects such as the future of the economy, business forecasts, government policy and buyer's tastes.

This evolution has occurred primarily because of continually improving hardware and software technology. As the capacity

and capabilities of computer systems increased, the applications of information processing increased. The first systems were confined primarily to the automation of clerical work consisting of the processing of transaction data into scheduled reports [Ref. 47, p. 34]. Business applications were in the financial area (payrolls, billing and accounting) because procedures in these functions were formalized and therefore the easiest to program, not because they were necessarily the most cost effective [Ref. 54, p. 100]. These systems were often referred to as operations systems because of their close involvement in the operations of the organizations which they served [Ref. 16, p. 30].

As Electronic Data Processing (EDP) capability evolved, computers were even assigned routine, low-level decision-making functions such as reordering for inventories, scheduling truck shipments, or preparing notices for delinquent accounts. Software programs were written to make these decisions mathematically. "Systems of this type have been referred to as administrative information systems . . ." [Ref. 16, p. 31].

Improved hardware technology permitted the integration of transaction files into a data base. Software was also developed to permit the interrogation, inquiry, and preparation of reports directly from these large data bases [Ref. 47, p. 35]. Most of the company's recorded data was maintained in the data base and many transactions were processed to completion at the time of initiation because all necessary file consultation, records creation, and computation functions

could be performed on demand. This generation of systems became known as data base management systems.

The next MIS development, as suggested by Drs. Sprague and Watson, are the decision models systems. Various types of models have been used in low-level, functional areas such as inventory control, production scheduling, production blending, etc. They suggest that more powerful and inclusive decision models be interfaced and combined with each other in order to satisfy new, unique information requirements. A new orientation of decision models would directly aid the top level manager who is making policy and strategic decisions in his decision-making processes. The three levels of models foreseen by Sprague and Watson are strategic, tactical and operational [Ref. 48, p. 40]. Both reports on operations and studies on future situations would be served simultaneously from a massive, integrated data base. Updating the data base would be essentially automatic and immediate by direct sensors, counters, etc., and the total information system would become the master intelligence network for the entire organization.

C. HIERARCHY OF INFORMATION SYSTEMS

A hierarchy of information systems is also described by Dr. Hare [Ref. 19, p. 192], where he has classified information systems by their complexity as follows:

> A. Operations. Standards fixed. Mostly deterministic data, deterministic logic. Stable situation. Little or no prediction or choice needed. Single plan of action, although many subconditions and options may be possible. Corresponds to application program in data processing.

B. Tactics. Standards involve some uncertainty. Data subject to error. Logic involves complexity beyond capability of brute force methods. Selection and simplification required. Analytical techniques may, or may not, be available. Tactical objectives subject to change. Possible instability in processing, or in priorities, values, or goals. Many alternate plans may be available in memory. Short-range prediction or choice needed. Corresponds to supervisory control programs in data processing.

C. Strategy. Standards, values, goals, depend on personal or political choice in addition to fixed constraints. Almost infinite choice combinations to consider. Selection problems at all points predominate. Rational logic and stability cannot be assumed. May innovate not only alternate plans of action but also goals and values used to evaluate plans. May be removed from reality by intermediate filtering of (time or delays in) lower-level information feedbacks or scans of environment. May be overloaded by information volume and variety. Possible pathological, self-destructive choices and actions. Lower-level systems may have to be bypassed to maintain external and internal realism. Long-range prediction and choice needed - combined with wide scan and awareness while present plans are fixed. Corresponds to human development of new programs, both application and supervisory (including redesign of total information system), in data processing. [Ref. 19, p. 193]

Moving along this hierarchy from the lower level to the higher level, the complexity and the level of uncertainty increase. Also, the number of variables to consider and the alternatives to choose from increase. Dr. Hare goes on to state that most of the success to date with information systems has been at the operational level [Ref. 19, p. 193].

Every organization also has a management hierarchy and the information requirements differ between levels of management. The evolution of MIS discussed above follows the management hierarchy. Early information systems satisfied low-level management needs (operational). Later, more recent, management

information systems are capable of providing information for executive decision-making (strategic).

D. HIERARCHY OF MANAGEMENT RESPONSIBILITIES

Several management authorities have categorized management functions and responsibilities in a hierarchy that is distinctly correlated to the hierarchy of information systems. Ansoff describes management decision-making in three categories as strategic, administrative and operating decisions [Ref. 2, p. 5] which are very similar to Dr. Hare's classification of operating, tactical, and strategic levels of information. He states that operating decisions usually take up the bulk of the firm's energy and attention, where the objective is to maximize profitability of current operations. Major operating decisions involve resource allocation (budgeting) among functional areas, scheduling of operations, monitoring of performance, and applying control actions. Administrative decisions are concerned with structuring the firm's organization and resources, which involves structuring of authority, work flows, information flows, distribution channels, location of facilities, development of raw material sources, personnel training, financing and acquisition of facilities and equipment. Strategic decisions are primarily concerned with the relation between the firm and its environment or, more specifically, the problem of deciding what business the firm is in and what kinds of business it will seek to enter. Strategic decisions involve the firm's goals, objectives, diversification, product-mix, markets, and growth. Ansoff also notes these other differences:

(1) operating decisions are repetitive, strategic are non-repetitive, (2) operating decisions are decentralized in the organization, strategic are centralized at the headquarters level, (3) operating decisions are self-regenerative, that is, they are automatically generated at all levels of management and those beyond the scope of lower management become the concern of top management. Strategic decisions are not self-regenerative because they make no automatic claims on top management attention and, unless actively pursued, they may remain hidden behind operational problems [Ref. 2, p. 9].

A management information system needs to be designed for the particular management situation. The output should serve a viable management decision-making function. The hierarchy of management responsibilities and the associated types of decisions made at each level are helpful in understanding the informational needs of an organization and an organization's need for a MIS.

VIII. MAINTENANCE MANAGEMENT INFORMATION

Previous chapters have described Management Information Systems in general terms and have described the source of funds into a Public Works Department. The accounting for these funds and the types of reports being generated, both financial and managerial, have been discussed. This chapter will examine the Public Works Officer's information needs in the specific function of maintenance management. This will be accomplished by first identifying the type of management the PWO is involved in and then identifying the information that will aid him while exercising his management functions. Last of all, a comprehensive information system is described that could exist if no cost constraints were in effect.

A. PWO AS AN OPERATIONAL MANAGER

The Public Works Officer is involved in a very diverse line of work. In Chapter II, it was shown that he is responsible for managing transportation, utilities, real property maintenance, engineering, and family housing. The people that work in these functions represent a variety of crafts including equipment operators, automotive mechanics, boiler operators, plumbers, carpenters, painters, electricians, etc. The administrative functions that must be performed include personnel administration, facilities planning, budgeting, material management, etc. In order to better understand the complexity of activities going on and the variety of management actions required, the two categories of strategic management and

operational management are analyzed in relation to the Public Works Officer. These categories were discussed in Chapter VII under the hierarchy of management decision-making.

Most of the authorities on management agree that in the business world, strategy involves the overall questions of what business the firm is in and what is its purpose for being in that business. Strategy defines the purpose for being in business by examining the environment within which the organization exists and establishing the overall goals and objectives for the organization. Policies are determined to provide the guidelines with which to implement operations for accomplishing the objectives.

"Strategic management," as the term is used here, is the process of applying strategy while exercising management. Strategic management particularly involves long-range planning and policy-making to determine or change the direction or the character of the organization. Long-range does not refer to the time period required to formulate or implement the plan, but it refers to the relative time period that the plan will be in effect. These decisions affect the physical, financial and organizational framework within which operations are carried out.

"Operational management," as the term is used here, is the process of implementing specific actions in order to accomplish the organization's objectives effectively and efficiently. Operational management is concerned with short-range effects of a limited nature to the firm as a whole. Control is important where predetermined procedures are being followed as

established by strategic management. Automation is feasible because activities are repetitive and output is accomplished with a fixed set of rules.

Authorities in the literature have made similar distinctions between high-level and low-level management functions. Some have made the distinction by differentiating between those actions that required the use of judgment and those that could be completely governed by formal decision rules. Simon makes a distinction between decisions based on value judgments and decisions based on facts and he refers to these as non-programmed and programmed decisions [Ref. 46, p. 4]. Anthony makes a distinction between planning systems and control systems [Ref. 3, p. 2] and creates a framework for analysis consisting of strategic planning, management control and operational control [Ref. 3, pp. 15-18]. Dr. Anthony feels that strategic planning is carried out almost exclusively by top-level management. Those activities under management control comprise a mixture of both planning and control. The activities classified under operational control are essentially a pure control function and are in the realm of lower-level management. Symonds makes a distinction between strategic management and tactical management [Ref. 49, p. 8]. Ansoff makes the distinction, as discussed in Chapter VII, between strategic and operating decisions which are made by different levels of management.

An analogy has been made that the Public Works Officer is similar to the Chairman of the Board or the Chief Executive Officer in a civilian firm. Management information systems are

prevalent in the civilian world of business corporations and it is tempting to adapt a MIS that has been effective elsewhere to the Public Works Officer's situation. A MIS should be designed for the specific situation, though, and what might be effective in one situation could be destined for failure in another situation. It is contended that the analogy to the Chairman of the Board is an exaggeration mainly because the PWO is not involved in strategic management to the same extent as top-level management in the civilian world. This will be illustrated by citing examples of activities in a business organization.

1. Choosing Company Objectives.

Obviously, top-level management is involved in strategic management that determines the organization's objectives in a civilian firm. The Public Works Officer is seldom involved in this type of activity though. The mission of a naval shore activity is predetermined for him long before he arrives on the scene by management at the DOD or SECNAV level. Command goals or objectives are often written, but they are predetermined to a large extent by the preassigned mission.

2. Planning the Organization.

Here again, management in the civilian firm is directly involved in planning and structuring their organization for themselves. A naval shore activity is active in planning and structuring their organization, but within limiting constraints. The activities that can be pursued within their assigned mission are regulated, the total number of people that can be hired is limited and their budget is constrained. The Public

Works Officer, of course, must work within this framework. His functions are generally predefined and he is obligated to organize along functional lines. NAVFAC has prescribed typical organizational structures for a Public Works Department according to its size. The Public Works Officer is responsible for personnel administration and he controls supervision of his personnel but these functions are operational management rather than strategic management.

3. Setting Personnel Policies.

The civilian firm is free to set its own personnel policies and is constrained only by broad governmental regulations and possibly more specific union regulations. Top management can set policy though, in order to better achieve the corporate goals. Personnel policies for the Public Works Officer are established by the Office of Civilian Manpower Management (OCMM). The PWO does not set personnel policy, but rather he implements policy and this is operational management.

4. Setting Financial Policies.

The civilian firm must abide by various regulations and accounting procedures for providing financial information to persons and agencies external to its own organization. Within its own organization, however, it is free to set policies and, therefore, procedures for accounting that will suit its own needs best. The Public Works Officer must conform to procedures promulgated by the Navy Comptroller Manual.

5. Capital Expenditure Decisions.

Top management in a civilian firm exercises strategic management in deciding on all of its capital expenditures. A Public Works Officer does not and cannot make any capital expenditure decisions because they are not within his authority nor that of the command to which he is attached.

A better analogy would be to compare a naval shore activity with a division in the civilian corporate structure. Several divisions are normally subordinate to a corporate headquarters and there are normally several naval shore activities reporting to a headquarters command. Strategic management is exercised primarily at the corporate or headquarters level and corporate policy guides the divisions. Likewise, Navy-wide policy guides the naval shore activities. Divisions primarily exercise operational management which is the analagous contention here, that naval shore activities primarily exercise operational management.

Since the Public Works Officer is within the naval shore activity organization, it follows that he also primarily exercises operational management rather than strategic management. More specifically, it is evident that his function of the maintenance of facilities primarily involves operational management. This fact is important in analyzing his informational needs.

Symonds states that the information needs of operational management must be developed on the concept of management by exception [Ref. 49, p. 116]. He explains that once operating levels are predetermined in order to carry out the

strategic objectives of the organization, evaluation and control can be exercised on an exception basis. He promotes the use of standards and budgets and recommends that the information system be programmed to report variances from standard or deviations from budget.

B. MANAGEMENT BY EXCEPTION

The management principle expressed by NAVFAC in the CECOS Manual is also management by exception and states that all Public Works management systems are based on this principle. NAVFAC views the process as one of laying out plans before the fact, based upon uniform standards, and analyzing variances in the performance data after execution of the plan [Ref. 40, p. xii].

Management by exception has also been defined by Lester Bittel in his book entitled Management by Exception where he states:

> Management by exception, in its simplest form, is a system of identification and communication that signals the manager when his attention is needed; conversely, it remains silent when his attention is not required. The primary purpose of such a system is, of course, to simplify the management process itself - to permit a manager to find the problems that need his action and to avoid dealing with those that are better handled by his subordinates. [Ref. 6, p. 5]

The informational needs of the Public Works Officer should then be based on exception reporting if his management systems are based on the principle of management by exception.

C. MAINTENANCE MANAGEMENT INFORMATION NEEDS

Every organization has an information system, even though it may not be formalized and thought of in terms of an information system. People working together in a shop or an office communicate with one another and are thus sharing information. Even a small business organization generates customer orders, invoices, material requisitions, accounting statements and numerous other files of information. A business cannot operate without a continuing flow of some kind of information depending on the size, complexity and structure of the operation. Management requires information in order to do an effective job of managing.

If information is considered as an aid to the decision-making process, it is necessary to examine the decision-maker to see what kinds of decisions he is required to make and what factors are influencing his decisions. The basic factors affecting every decision-maker are the organization's objectives (or missions, in the Navy vernacular). Missions are customarily stated for high level commands such as DOD (defense of the Nation), the Navy, the naval shore activities, and even for Public Works Departments in general. NAVFAC has published the following objective statement for maintenance management [Ref. 30, p. 2-1]:

> The basic objective of maintenance management is the optimum use of available manpower, equipment, material, and money by:
>
> 1. Providing effective support and response to command requirements.
> 2. Increasing the productivity of the maintenance work force.
> 3. Insuring that the maintenance of facilities is at the proper level or standard.

4. Achieving cost reductions in the maintenance of facilities and related operations.

The authors are of the opinion that this objective statement is difficult for the Public Works Officer to work with because the way it is stated makes it difficult to measure the extent to which the objective is attained. For instance, how can effective support to command requirements be measured? If it can be measured, how does it relate to the optimum use of resources, which is the objective statement?

The authors have written an objective statement for maintenance management as follows:

> To provide maintenance that will allow optimum operating time and use of facilities at minimum cost and at an acceptable level of maintenance.

The authors' objective statement requires that facilities be maintained at an acceptable level of maintenance which is the same as the NAVFAC statement that a "proper" level of maintenance be insured. The level of maintenance is predetermined for each facility and item of equipment commensurate with the activity's mission. Deficiencies are noted in that level of maintenance during the inspection process which identifies the maintenance or repair work required to uphold the facility's condition. The information that is required to meet this portion of the objective statement is obtained through the raw inspection data.

The objective to provide maintenance at a minimum cost in the authors' statement is considered more specific than optimizing the use of money or reducing costs in the NAVFAC

statement. Also, the available manpower, equipment and money can all be equated to common units of money. So, optimizing all these items is equivalent to optimizing money or costs. It is felt though that minimizing costs is a more specific objective where only one cost function is being considered and there are not two cost functions that are in conflict. The cost of maintenance is going to be determined primarily by the predetermined level of maintenance. Obviously, it will cost more to maintain facilities at a high state of maintenance than it will to maintain facilities at a very low state of maintenance (bordering on neglect). Once the level of maintenance has been determined, decisions for cost minimization are made on how to accomplish the work. The method of accomplishing the work, whether by local station forces, contract forces or some other method should be primarily a cost decision in order to meet the objective. The information needed, obviously, is the relative cost of each method.

There are also other cost considerations in the maintenance decision process. The type of maintenance or repair work might be affected by the life expectancy of the facility. Obviously, it would not be cost effective to install a twenty-year roof on a building that will be demolished in two years. Also, new types of materials might be available that would decrease the installation cost and still provide benefits equal to other alternatives. On the other hand, materials might be available that are relatively expensive, but their use will eliminate recurring maintenance and, therefore, reduce life cycle costs. The information needed to make these decisions

is the life expectancy of all the facilities and pieces of equipment and information on the types of materials available on the market including their cost, physical characteristics, applications, durability, etc.

The objective of maintenance should also allow optimum operating time and use of facilities, which were constructed for a specific purpose. In order to yield their intended benefit, these facilities need to be available for use for their intended purpose. If they are unavailable for their intended purpose due to lack of maintenance or repair, the objective is not being met. It is realized that the objective of availability of the facility and the objective of minimum cost may conflict. This leads to an optimization decision if the most economical solution is to be found. Information that is required to meet this objective are the downtime due to maintenance, the cost of this downtime in the organization and the cost of required maintenance.

The NAVFAC objective statement also requires effective support and response to command requirements. It is the authors' opinion that the long standing requirements are expressed in the level of maintenance. The unexpected or infrequent requirements are usually more of direct concern to the Public Works Officer himself and indirectly to maintenance. Therefore, it is felt that this clause of the objective statement should be in the objectives of the department as a whole and not only applicable to maintenance.

Increasing productivity is considered to be a poor choice of words where "maximizing productivity" might be more

appropriate as an objective. Nonetheless, productivity is considered to be a sub-objective of cost minimization. There are undoubtedly other sub-objectives at any specific activity because of the specific circumstances at that activity.

Theoretically, these decisions to attain the maintenance objective (however stated) should be made when developing the annual plan for maintenance. In practice, however, an annual plan cannot be formulated and adhered to for the entire maintenance effort.

MO-321 states that 80 to 85% of the productive labor should be controlled [Ref. 30, p. 10-9] by the maintenance management system described in Chapter IV. An objective of the system is to control work input by continuous inspection. There is some work that seems to defy being controlled and preplanned such as emergency work required for breakdowns or accidents. There is the generally accepted theory, though, that preplanned work in the form of preventive maintenance will reduce the amount of emergency type work in the future. The point is that the manager should be able to control and preplan the majority of the maintenance work and this could then be transposed into a financial plan or budget.

In the government, the budget is not only the financial plan, but an approved budget is the resources input. The products produced or the services provided make up the resources output. The information needs of the Public Works Officer in formulating the budget for maintenance are quite different from his information needs in executing the budget. This

section so far has discussed his informational needs in formulating the budget or the input phase of the process.

Budget execution is the process established to achieve the most effective, efficient, and economical use of financial resources in carrying out the program for which funds were approved (Chapter III). In the case of Public Works maintenance, it is the process to achieve effective, efficient and economical use of financial resources in carrying out the annual maintenance plan.

The maintenance objective was used in formulating the annual plan. The execution process should measure actual performance in attaining the objective compared to the planned performance for achieving the objective.

The maintenance objective statement seeks to obtain optimum operating time and use of facilities. The information needed to measure the effectiveness of maintenance is the amount of time the facility is available for use or, conversely, the amount of downtime due to maintenance. To measure efficiency, it is necessary to know the length of the actual downtime compared to the planned downtime.

The maintenance objective seeks to provide maintenance at minimum cost. The information needed is the actual cost compared to the planned cost, assuming that the planned cost was minimized in accordance with the objective.

The maintenance objective requires that facilities be maintained at an acceptable level of maintenance. The information required is inspection data after completion of the work

to compare with the original inspection data that identified a deficiency.

In addition, it is important to measure the overall progress compared to the overall plan throughout the year.

The use of the exception principle should isolate the information reported to management to that which falls outside some predetermined limit or range. In this way the manager has the activities that are most apt to need remedial action brought to his attention and he is not deluged with large quantities of routine information that does not require action.

D. A COMPREHENSIVE MIS FOR MAINTENANCE MANAGEMENT

This section will describe an idealistic, comprehensive information system that could technically be provided if there were no funding constraints.

Information required to maintain facilities at a predetermined level of maintenance is obtained from the inspection process. In general, this function is thought to require manual collection of data, but there are some cases where the collection of data could be automated. Boiler plant operation, which is a function of the Utilities Division, serves as a good example. Sensors could collect data on fuel, feedwater and steam and transmit this data directly into storage in the computer center. In fact, the operation of the boiler plant might be computer controlled and data collected from the control process could be stored for future reporting purposes. In this case, the data collected for managerial purposes is a by-product of the control process. Similarly, data from other

pieces of equipment could be collected and stored by automated, computer equipment. Certain data, such as high temperatures in shaft bearings, could indicate imminent failure and would allow repair to be done before failure occurs and at a lesser cost.

The computer is readily adaptable to cost minimization problems as shown by the widespread use of linear programming, simulation and other mathematical techniques used in operations research. Nearly all of the decisions in the work input control process are programmable on the computer. The method of accomplishing the work, whether by local station forces, contract forces or some other method, can be quickly calculated by the computer. The procedure to develop detailed estimates for each method of accomplishment are too time consuming when done manually and at best an engineering estimate of each method is used for comparison. The computer could rapidly calculate detailed cost estimates for any repair or maintenance work based on engineered performance standards, show the impact of various alternatives to the work schedule and make minimization decisions.

The types of materials to incorporate in a job are affected by many variables such as cost, availability, durability, etc. In practice, the decision-maker often considers only one or two variables because that is easier and takes less time. If material selection were done by the computer, however, entire catalogues of information in the data files could be searched, comparisons of both present costs and life cycle costs made between the alternatives and the impact of

later delivery of the materials to the work schedule could be made almost instantaneously.

The computer can also be used to optimize the downtime of facilities. The optimization of maintenance goals compared to the cost of downtime is readily adaptable to a computer solution. The cost of downtime for each facility and piece of equipment could be stored in the data files. The cost of doing the work during normal working hours, during after-hours with a wage differential, or by other methods could be compared with the facility downtime costs to provide an optimal solution. Similarly, the lack of maintenance on a facility or piece of equipment might preclude the intended use of that item. The computer could calculate the economic benefits of providing various degrees of maintenance to get the facility back into use. An output report could show the lost economic utility cost to date and projected into the future.

Measuring actual performance in the execution of the budget is readily adaptable to automation and most of the data is presently being collected. Measuring the actual performance of resources used in the work can be obtained from the employees' time cards or labor distribution cards and the material requisition cards. The output report can compare the actual cost of resources used with the planned cost as estimated in the job order.

Measuring the downtime of facilities could be accomplished with time cards at the location of the facility or piece of equipment. The output report could compare actual downtime

with planned downtime estimated in the job order and scheduled on the work schedule.

Discussion of the comprehensive MIS has been centered on the individual job order up to this point. This might seem adequate since the annual total is merely a summation of individual job orders. Financial constraints and expenditure rates apply to the annual budget, however, and it is essential to measure performance against the annual financial plan, which is a transposition of the annual maintenance plan. The authors prefer the term Budgeted Maintenance Plan (BUMP) which connotates a direct association with the budget. The comprehensive MIS should include an output report that compares year-to-date performance of job orders collectively to the BUMP.

When the computer has minimized the costs for each job order, it could accumulate all the job orders into the BUMP and transpose it into a budget. When the approved budget has been received, the computer can readjust the BUMP, schedule the work, order the materials and print the job order from the previously calculated detailed estimate.

Variances in the individual job orders and variances between the planned versus the actual BUMP are an application of the exception principle. The computer is efficient at sorting and editing and can report only that information that requires the Public Works Officer's action. Variances that exceed a predetermined limit or range can be presented in a summary and the routine information can be stored on tape, available on call.

Trends are another important part of an information system that could be graphed and printed by the computer. Trends not only help to predict the future but they visually show the manager cyclical variation, seasonal variation, and high and low points that are hidden in averages. As an example, a work center could double its productive effort during one month and not produce anything the second month. The actual year-to-date effort compared to the planned effort at the end of the second month would show no variance, but the trend is dangerous and needs investigation by management [Ref. 7, p. 11].

Finally, the comprehensive MIS could provide financial accounting. Even if accounting is performed by another department, the managerial reports just discussed could be reconciled with the financial accounts. This would provide a means of checking total figures and thereby assure greater accuracy of information to the manager.

It is realized that the comprehensive MIS just described tends to be impractical from the cost standpoint. It would be costly to install every aspect described above and probably costly to maintain, but it would provide the maintenance manager with the information needed to achieve the maintenance objective. In comparison, the existing information systems are analyzed in the next chapter to see how well the maintenance management informational needs are being fulfilled.

IX. ANALYSIS

A. WORK INPUT ANALYSIS

The inspection process in Public Works, whether continuous or periodic, collects information on the condition of facilities. Deficiencies identified during the inspection process generate work input. Some inspections could technically be automated by installing computer-controlled sensor equipment but there is no clear indication that this would be either economical or desirable. The cost of sensor devices in some cases would exceed the cost of the item being monitored and would exceed the benefit derived from identifying a deficiency. In other cases, such as termite damage or storm damage, manual inspection is the only practical method of identifying deficiencies.

The existing methods of manual inspection of facilities are considered to be more practical than expensive, automated methods. Manual inspection also offers the opportunity to make minor repairs and adjustments on-the-spot, such as done in Preventive Maintenance Inspections. The inspector also sees peripheral conditions at the inspection site and other facilities enroute to the inspection site that are not perceived by a sensor device with limited vision.

The existing, manual methods of planning and estimating in work input control are primarily constrained by the planner and estimator time available. These people generally do not have enough time available to make several detailed

calculations on each job order, nor do they have time available to search catalogue information for the best materials to incorporate into the job. This is a case where data is available but it is too costly to process manually.

Alternative methods of accomplishing the work are currently controlled by various constraints of public law and policy regulations. Even within these constraints, cost should be a consideration because it is an aspect of the maintenance objective. If calculated costs for each alternative were available, better decisions would be possible. Comparisons between jobs could be made and those with the greatest cost advantage could be chosen within existing constraints.

Life cycle costs are rarely, if ever, calculated by present methods used in work input control. The situation often exists where more permanent but more costly materials could be used on a job now that will reduce future maintenance costs. The maintenance budget is limited, however, and that forces a decision in the planning stage for a lower present cost. If the calculated life cycle costs were available, better decisions would be possible even within the budget constraint and better budgeting for the future would be possible. Concepts of the comprehensive MIS as discussed in the last chapter might prove to be cost effective in the work input control process. Computers can generally perform mathematical computations at a cost advantage over manual methods because of their great speed. Better information would yield better decisions and the benefits of this advantage might be worth the cost.

Downtime of facilities or equipment costs the government money because these facilities are not useable for their intended purpose. This fact is readily understood in the situation of an industrial plant where a breakdown in the assembly line stops production. Downtime is also an important factor in the Navy when the downed facility directly affects the mission of the activity, such as a downed runway at an air station, a downed drydock at a shipyard, or unusable facilities at a training activity. There are real costs associated with these downed facilities and the operating time of the facilities should be optimized in accordance with the maintenance objective. Another example where the costs are more apparent is in the utilization of family housing quarters. If the situation exists where quarters are available for use on-station and eligible service members are residing off-station, the cost to the government for not utilizing those quarters is the monthly housing allowance paid to members living off-station. The maintenance objective seeks to minimize downtime costs such as these when the facility is downed due to maintenance. Present information systems in Public Works do not consider these costs while the comprehensive MIS would.

From the practical viewpoint, the costs of calculating and reporting downtime may exceed the benefits derived. The economic principle of downtime is considered so important though that the Public Works Officer should be aware of the fact that ongoing maintenance work or lack of maintenance work might be denying the use of a facility at a cost to the government. The information that a facility is downed could easily

be incorporated into present reporting system or the proposed PWDMS. Job orders could be coded when written to indicate that a facility is either downed due to lack of maintenance (and back in use when maintenance is completed), downed while maintenance work is being accomplished or neither. Present performance reports being run on the computer could be programmed to sort downed facilities into a special listing.

Scheduling is presently done manually and the PWDMS proposes to automate the system. Scheduling of work is important when the manager has real constraints. He must sequence the work in an orderly fashion to effectively utilize resources. An automated scheduling process allows for the rapid consideration of the variables of relative importance such as craft backlog, manpower and material availability, funding, job size, engineering, planning, and estimating for each job order and allows the manager to be more efficiently responsive. Job step sequencing is important in the efficient employment of both men and materials and serves as an aid in minimizing cost and optimizing facilities downtime for maintenance. The computer allows the maintenance manager to rapidly respond to unforeseen delays by scheduling around the delay causing event. Variations in the work schedule can be calculated by the computer and many variables can be considered, which is generally not cost effective when done manually. A realistic advantage of automated scheduling will be a decrease in manhours needed for weekly shops scheduling meetings. Automated scheduling also allows the scheduling to interface with performance reporting on each job order to gain more current and factual information.

B. FINANCIAL ACCOUNTING ANALYSIS

Financial accounting is the responsibility of the comptroller at a naval shore activity and, more specifically, the Authorization Accounting Activity (AAA). The present series of RMS reports put out by the AAA are designed for accounting and reporting purposes and the existing Public Works management reports could almost be considered a by-product of the RMS accounting process because the input data is the same.

The operating Budget/Expense Report (NAVCOMPT Form 2168) provides management with lists and totals of work units, man-hours, and accrued expenses, for each budget classification code, functional/subfunctional category, and cost account cumulative to date for each cost and responsibility center. Total cumulative expenses are reported separately for direct expenses and reimbursable expenses.

The actual expenses of the Performance Statement (NAVCOMPT Form 2169) are the total expenses of the Operating Budget/Expense Report and it is prepared for each cost center and responsibility center. It provides management with the actual fiscal year-to-date totals for accrued expenses and work units which are compared with the approved operating budget for each classification code, functional/subfunctional category and cost account of the operating budget. If work units are not used, as at the Naval Postgraduate School, the report provides no appreciable benefit to management. To partially fill this void in information, the Comptroller manually provides a Status of Operating Target (OPTAR) Report which provides a monthly status of funds authorized and funds committed by subfunctional category by cost center.

The Trial Balance Section of the Expense Operating Budget Financial Report (NAVCOMPT Form 2170) presents the financial status of all funds available under an operating budget. The net change in the Trial Balance of financial data is used by the major claimant's AAA for posting to the official program control ledgers.

The Budget Classification/Functional Category/Expense Element Report (NAVCOMPT Form 2171) provides detailed input to the major claimant for his summarization and submission to the Navy Cost Information System (NCIS) at the NAVCOMPT and OPNAV levels. The accrued expenses and gross adjusted obligations for the month and fiscal year-to-date are reported in terms of budget classification codes, functional/subfunctional categories, expense element and subheads thereof. The fiscal year-to-date expenses are balanced with the total expenses reported on the Operating Budget/Expense Report.

The maintenance manager is concerned with costs at the job order level and the RMS accounting reports do not provide this information. The RMS reports were designed for financial reporting and accounting purposes at an activity and they provide useful information on the status of total funds authorized and committed. This information is required for overall budget management and control.

Accounting is being performed by the comptroller and this function does not need to be duplicated in Public Works. Control over job orders written against the Public Works OPTAR is the Public Works Officer's responsibility and this is being adequately performed by the Fiscal Branch in assigning accounting data to job orders.

C. WORK PERFORMANCE ANALYSIS

The Tabulated Report A provides monthly information on the expenditure of labor hours in the various labor class codes of work in each cost center. The information is on an aggregate basis and is useful in the manual preparation of manpower summaries and the Maintenance and Utilities Labor Control Report. This report is useful to the manager because it reflects how labor has been charged for the period.

Job order estimates are based on engineering performance standards which allows for the comparison of actual and planned costs. Currently, the Tabulated Report B provides cost data on completed job orders. It reports the planned and actual costs in terms of labor and material and displays the information by cost center elements (work centers), and total variance from the estimated cost. Job orders with variances of certain magnitude based on a standard criteria can then be investigated as to the cause of the variation. This procedure is complete reporting with exception evaluation. In the case of the Naval Postgraduate School (NPS), the Tabulated Report B computer program is written to key on a customer completion message originated in the Public Works Department. On receipt of this message, the computer center acts to clear and places the designated job order on a completed job order listing. Typically, this clearing procedure is completed before all material requisitions expenses are processed by the computer center. The result is the reporting of incomplete information which is never updated for variance reporting. The present computer program needs to reconcile all material requisitions for the

given job order and when all requisitions are received, to print the completed job order information and then transfer the job order to the completed listing.

Additionally, the fact that the Tabulated B Report is not reconciled with the official accounting record and has overlapping reporting periods, causes the report to have poor credibility. Since the Public Works management reports and the accounting reports do not cover the same time period, they cannot be reconciled with each other until the reporting periods are made compatible. The end of the month for the Tabulated B Report, for instance, is the last day of the last pay period in the month. The end of the month for the accounting reports is the last calendar day of the month. Both types of reports are using the same input data, so it is feasible to reconcile them with each other. Reconciliation of the two types of reports will not only reduce errors but will permit comparisons by management between financial information and work performance information. This factor is considered important for effective management analysis.

The Public Works Department Management System (PWDMS) proposes to provide Completed Work Authorization Reports on the consolidated basis, the work center basis, and the cost center basis as well as to automate the Maintenance and Utilities Labor Control Report. This would replace the Tabulated A & B Reports and would provide estimated and actual job cost data for performance and status evaluation. The automation of the Labor Control Reports leads to the logical step of providing visual display charts for labor utilization by labor class

codes. This charting would show the acceptable range and the actual performance by work center and be consolidated for the Maintenance Division.

Trends are presently graphed by manual means when done at all, using input from the Maintenance and Utilities Labor Control Report. This report is presently being prepared manually but the proposed PWDMS automates the report. The report provides meaningful ratios and indices of productive and overhead labor for each subcost center in man-hours and compares these to acceptable ranges. Because trend graphs have to be prepared manually now, the tendency has been to forego any benefits offered by trend graphs and to rely on other aids such as notes, old reports, or the memory. The manager should recognize that a visual graph of trends on display attracts more attention than a plain listing of numbers and is easier to read. With the implementation of an automated labor control report, such as provided by PWDMS, several worthwhile trend graphs become readily available as by-products of automation.

The Job Status Report lists all backlogged jobs which are pending either funds, materials, or scheduling. This report serves as the foundation to the job order scheduling process because it provides the status of each pending job order. Currently, the Job Status Report is manually prepared and, as jobs are scheduled, they are removed from the report. The PWDMS proposes to automate the Job Status Report and to provide status updates as the job moves through Public Works to completion. The automated PWDMS Job Status procedure is much superior to the manual procedure and it interfaces with the

PWDMS scheduling process. The automated procedure significantly improves the total workload identification system and aids management in its utilization of resources for facilities maintenance.

D. BUDGETED MAINTENANCE PLAN (BUMP) ANALYSIS

Control over individual job order performance can be exercised by the present Public Works management reports when that reporting system is operating effectively. This will also be true of the proposed PWDMS. There is no control over job orders collectively, though. There is nothing in the existing reporting systems that informs the Public Works Officer of work actually accomplished compared to work planned by the budget. This is why the authors propose the Budgeted Maintenance Plan (BUMP).

The budget is an annual plan of action in financial terms. BUMP is the annual plan of action in job order terms. It covers the same time period as the budget; it equals the same amount as the budget, but it is a more detailed description of the annual plan. The currently used lists of deficiencies do not accomplish this. Neither AIS nor BMAR cover the same time period as the budget. Neither of them equate to the budget in dollar amounts and neither of them are a plan of action describing the financial plan of action.

Periodically throughout the year, the Public Works Officer should compare the actual work performance to date to the BUMP. This could be a computer report in the existing reporting system or the proposed PWDMS after establishing BUMP on file in the computer center.

X. RECOMMENDATIONS

Further research should be conducted to determine the cost effectiveness of automated decision-making in the work input control process. The process of work input control in maintenance provides opportunities for cost savings. It is the opinion of the authors that many decisions are being made based on judgment or the experience of the decision-maker rather than costing out the alternatives because present-day dollars are always constrained. The decision-makers do not have a lack of information, but they lack the time to search the information, develop alternatives and calculate a detailed estimate of each alternative from which to make a rational choice. Better decisions are possible and it might be economically advantageous to automate planner/estimate decision-making.

A weekly listing should be made of facilities and major pieces of equipment that are not in use due to maintenance. Downtime of facilities or equipment due to maintenance costs the government money. Even if calculations are not automated to make downtime decisions, the Public Works Officer should be conscious of the fact that ongoing maintenance work or lack of maintenance work might be denying the use of the facility at a cost to the government. Job orders could be coded and present performance reports could list facilities that are not in use due to maintenance.

The existing Public Works management reports should be reconciled with the financial accounting reports to provide compatible financial and work performance information for effective management analysis. Financial accounting is the responsibility of the comptroller at a naval shore activity and the activity's assigned Authorization Accounting Activity (AAA). Existing Public Works management reports are derived from the same input data as the RMS accounting reports. In order for the manager to effectively evaluate performance, it is considered essential that information that is presented in accounting terms and in work performance terms be reconciled so that one type of information is compatible with the other.

Existing reporting systems and the replacement PWDMS should be utilized as modified by these recommendations. The existing system of Public Works management reports and the proposed PWDMS provide information on actual performance of individual job orders. In maintenance management, the PWDMS provides a significant improvement by automating job order scheduling. In other respects, the PWDMS essentially replaces existing reporting systems.

Variance reports should be summarized based on the exception principle to accentuate variances that exceed a predetermined limit or range. Exception reporting saves the manager's time and reduces distractions by remaining silent on matters that are under control. A summary of exceptional variances will eliminate the need for the manager to search for that information.

Graphs should be programmed, as part of the PWDMS Maintenance and Utilities Labor Control Report, to show trends of selected control indices and ratios. While the benefit of trend graphs is intangible, they are considered useful by management authorities. They display in one place, on one piece of paper, in an easy-to-read form, historical information that is otherwise not available without a considerable amount of searching. With an automated Labor Control Report, the computer has the information and merely needs to be programmed to print it in graph form.

The Public Works Officer should prepare an annual Budgeted Maintenance Plan (BUMP) to support the maintenance portion of the annual operating budget estimate and that then actual performance be compared to the BUMP throughout the execution period. Budgeting at the activity level is structured to respond to the macroeconomic needs of the PPB system. The microeconomic needs of the activity are not being fulfilled by the present PPB system. BUMP provides the microeconomic financial plan for maintenance at the activity level. BUMP should be integrated into the proposed PWDMS to include the use of BUMP for work input and the measurement of work performance against the Budgeted Maintenance Plan.

XI. CONCLUSIONS

Effective management information systems provide the means for operational control and evaluation. Managers at all levels of the organization are able to analyze and evaluate actual events to determine whether or not plans were achieved in relation to objectives and, if not, to investigate as to the causes of variances. The primary concern is to appraise the extent to which the organization is achieving its objectives efficiently.

Performance on individual job orders is being measured and can be evaluated against the maintenance objective. The existing annual plan is deficient though and the Budgeted Maintenance Plan (BUMP) is recommended to provide a means of evaluation on an annual basis.

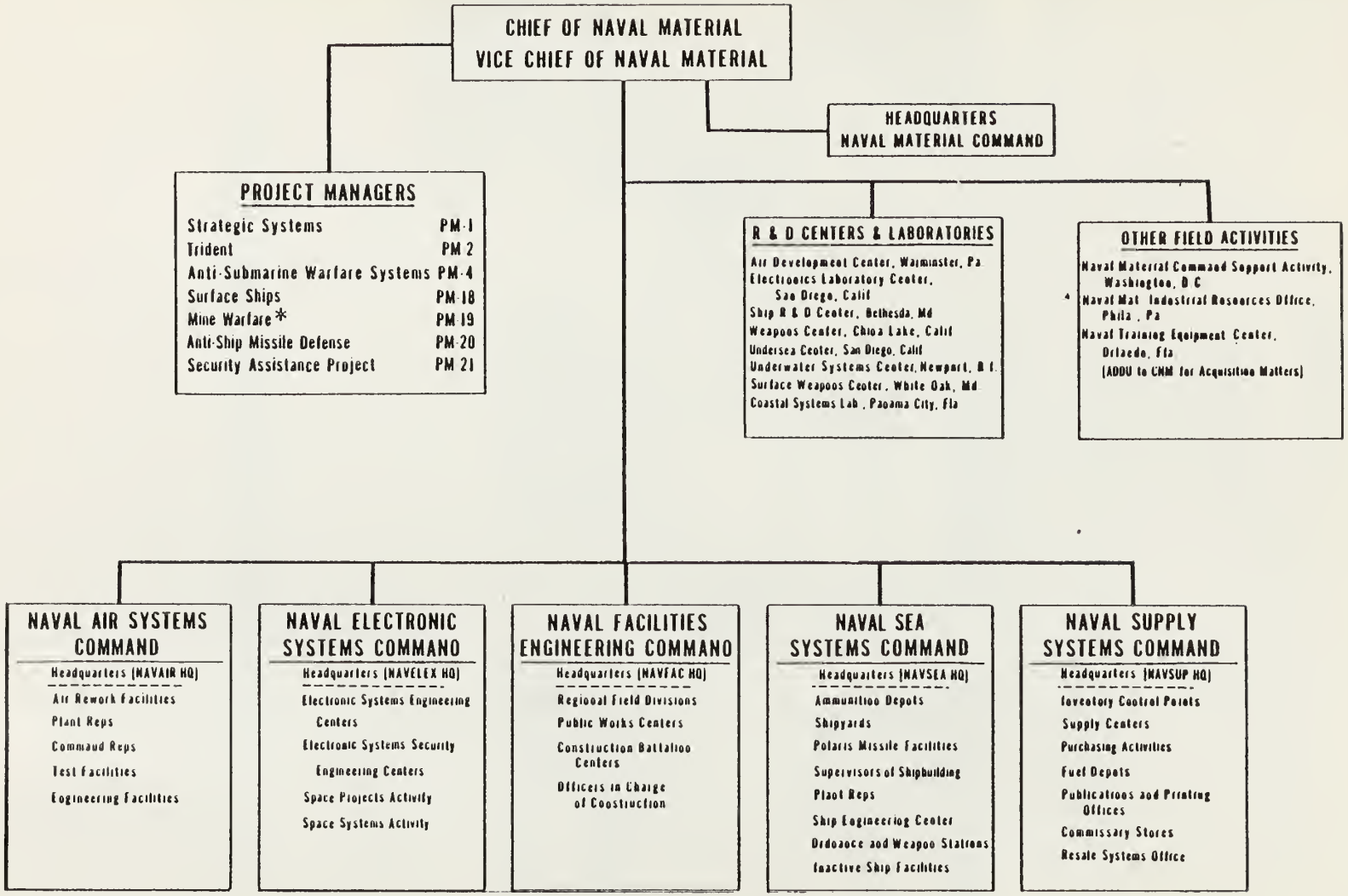
The concept of BUMP is compatible with the PPBS concept of budgeting. PPBS provides the macroeconomic tool for centralized decision-making on major policy issues and basic fund allocations. BUMP provides the microeconomic tool to transform objectives at the activity level into an efficient operating plan and budget, thus filling a gap at the activity level and reinforcing PPBS. Strategic management is served by PPBS and BUMP serves the operational manager.

The Public Works Officer is primarily an operational manager, although he also acts as a strategic manager. The formulation and execution of the annual operating budget is predominantly operational management. Automation of

administrative and operational processes affords a means of relieving the Public Works Officer of involvement in routine decisions and leaves him freer to exercise judgment in more complex situations. The large quantities of routine, operational work can be readily delegated to the computer and the nonroutine, strategic decisions can be dealt with by the Public Works Officer.

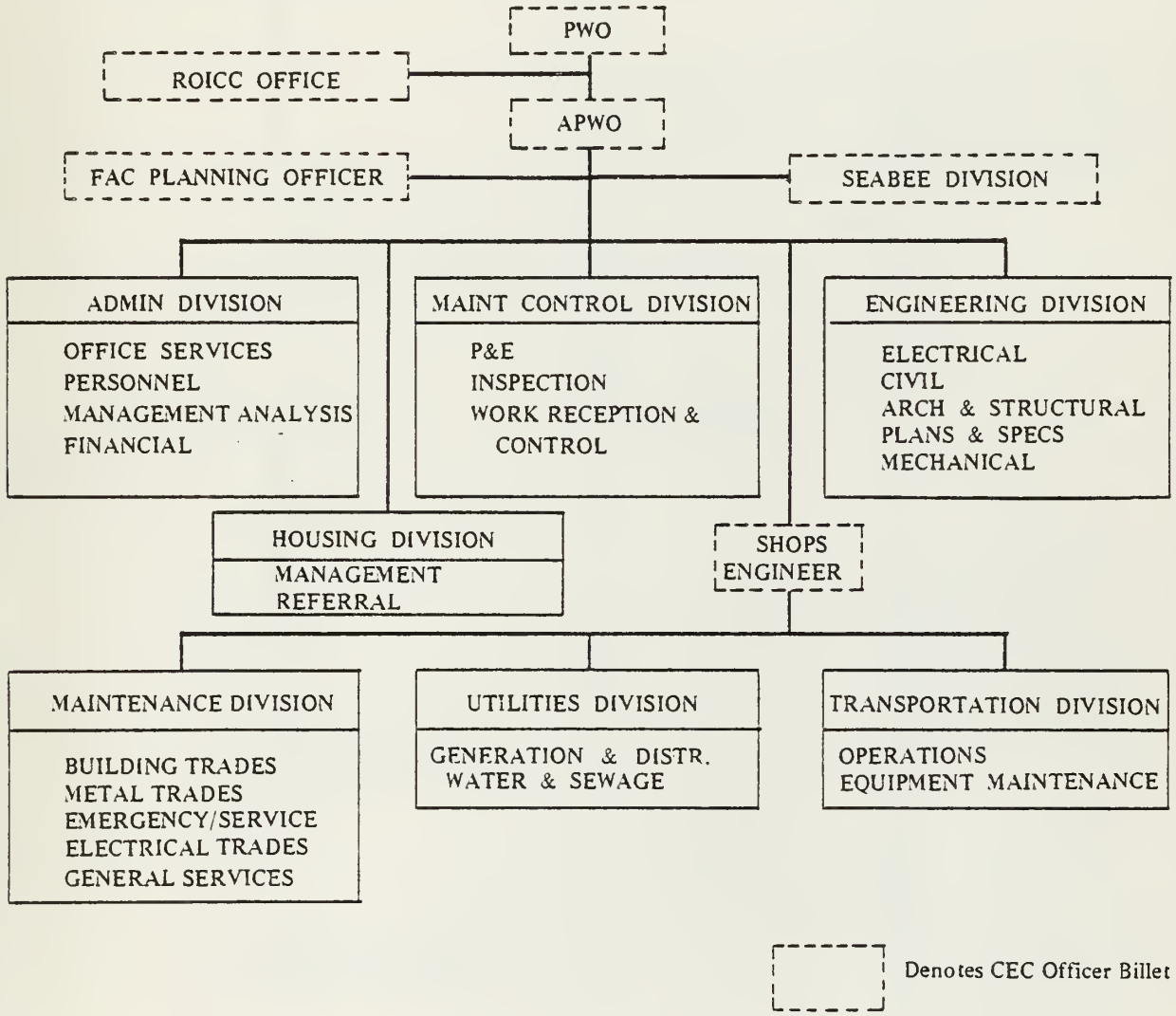
APPENDIX A

NAVAL MATERIAL COMMAND ORGANIZATION



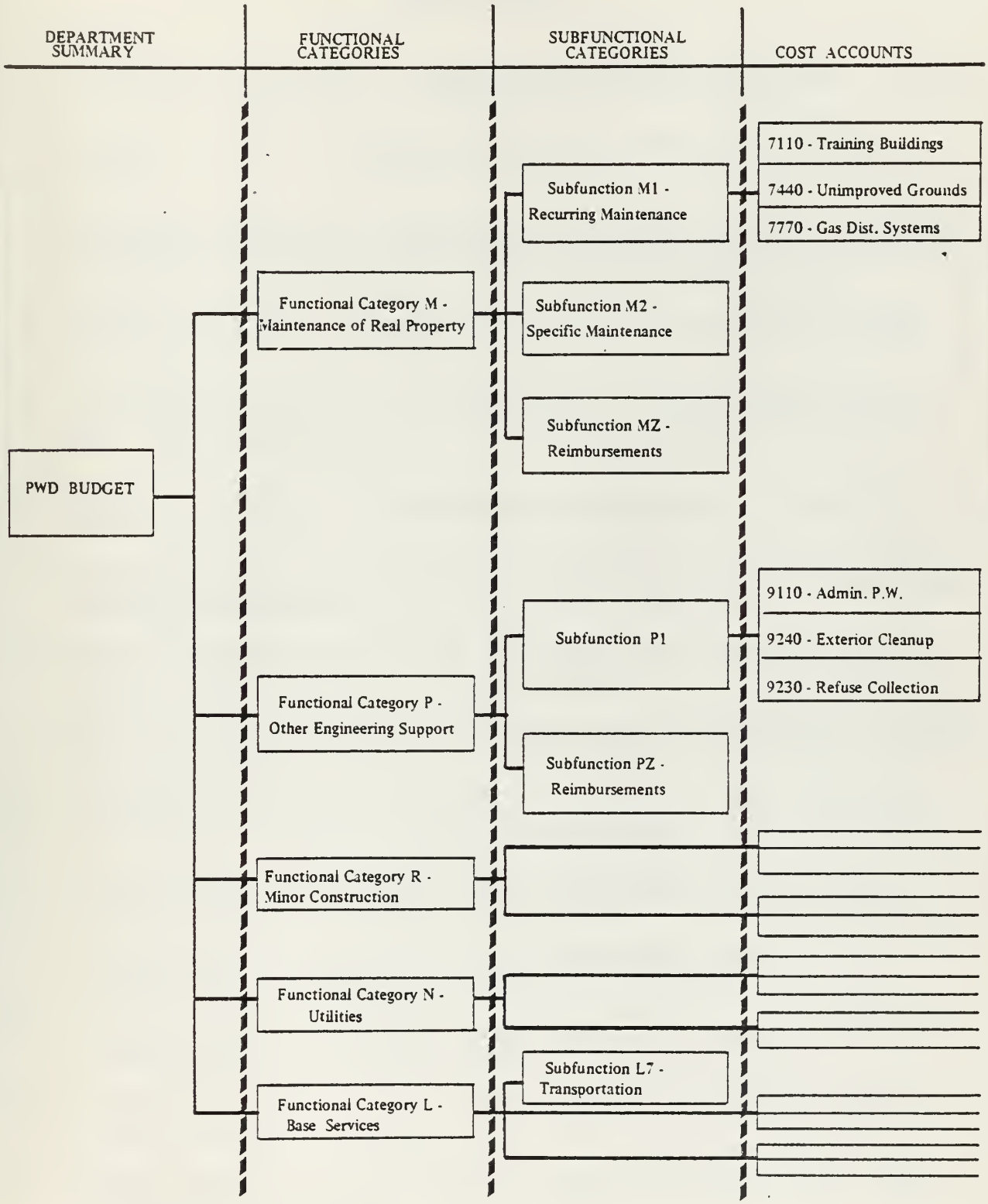
* to be disestablished 30 June 1975

APPENDIX B



STANDARD PUBLIC WORKS DEPARTMENT ORGANIZATION

APPENDIX C



TYPICAL SUMMARIZATION LEVELS ON O&MN BUDGETS

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